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VIEWS, NEWS AND INTERVIEWS.

It is reported that a fleet of electric launches may soon be in operation on the lake in Prospect Park, Brooklyn, N. Y.

Electric railways are promised for Cairo, Egypt, next year, the concessionaires being Belgians; and Alexandria is expected soon to follow suit. There are several bidders for a concession for an electric railway from Cairo to the Pyramids, a distance of 10 miles, to accommodate the enormous number of Winter visitors to the Egyptian capital.

Another large water-power scheme is in process of development at Athens, Ga.

Manufacturers of electrical window signs and novelties seem to be doing a very good business just now. Considerable ingenuity is displayed in the methods used of adapting electricity to schemes for attracting attention. A novel device is the idea of a vendor of electric pianos. Over the sidewalk is fixed a large circular case containing a number of white, flexible, sinuous arms, moving from a common center. These are connected with the keyboard and follow the motion of the keys on a piano inside the store. When a lively tune is being played the bewildering gyrations of the tumbling bars in the case seem to have a constant fascination for the passers-by.

A new and amusing notice has been posted in Philadelphia trolley cars. It requests passengers to "remain seated until the car stops, and then get off in the direction the car is moving."

It is said that a slight faradic current applied morning and evening to the face, neck and shoulders will increase the flesh and greatly improve the complexion.

Another romance of the wires is reported. Miss Mamie Carroll, of Williamsburgh, Brooklyn, N. Y., made the acquaintance of a traveling salesman over the wires of the New York & New Jersey Telephone Company, by whom she was employed. She will marry him in September, it is said.

It is reported that a number of leading business men of Camden, N. J., are trying to persuade the General Electric Company to consolidate its factories at that place.

A big electric crane at the Edgar Thomson steel works, at Braddock, Pa., was recently wrecked and did a great deal of damage to the building in which it was located. While the electrical engineer was absent, some malicious or reckless person turned on the current and started the crane. It soon obtained a great velocity. The boom crashed through the roof of the building, and when the wires broke it swung around and knocked out a section of the wall of the building. The big wheels, weighing several tons, hung from the ceiling, and it was some time before they could be removed. Operations in the foundry were suspended until work could be resumed in safety.

On June 18 a private test of generator No. 1 at Niagara Falls was made. A speed of 300 revolutions was obtained and everything is reported to have worked successfully.

Cotton States and International Exposition.

Dr. Daniel C. Gillman, president of Johns Hopkins University, has accepted the position of Chief of the Department of Awards for the Cotton States and International Exposition, to be held at Atlanta, Ga., this Fall. This is a guarantee of the high merit upon which the awards will be based. President Collier has sought to make the Department of Awards the best ever organized in America, and in securing the services of Dr. Gillman, he feels that he has succeeded. The name of Dr. Gillman commands respect all over the world.

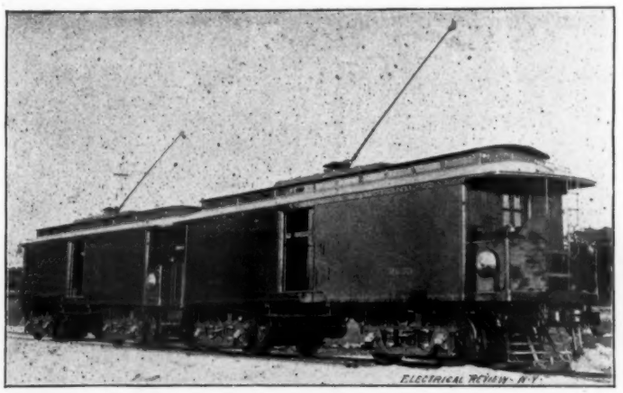

Fig. 1.—Combination Electric Motor and Baggage Cars for Express Service on the Nantasket Beach Line.

KIND WORDS.

FROM THE CHAMBER OF COMMERCE.

In a letter to the Electrical Review, Mr. George Wilson, secretary of the New York Chamber of Commerce, referring to our recent reproduction of Daniel Huntington's painting, "The Projectors of the Atlantic Cable," says:

"Mr. D. Huntington, the artist, in a letter received yesterday, speaks of your photogravure of the picture as the best of all that have appeared."

LIKES IT.

To the Editor of Electrical Review:

I like the Electrical Review very much. F. A. Beadle.

Anderson, Ind., June 24.

THE NANTASKET ELECTRIC ROAD.

A Glimpse of the Construction and Equipment of What is Destined to be an Important Step in Railroad History.

SPEED OF EIGHTY MILES AN HOUR REACHED WITH EASE—HEAVY FREIGHT TRANSPORTED—SUCCESS OF THE SYSTEM THOROUGHLY DEMONSTRATED.

Since the intention of the Old Colony Railroad officials to electrically equip the Nantasket Beach, Mass., branch of their road, with a view to demonstrating by actual operation the efficiency of electricity as a motive power when applied to steam roads, was first announced, the interest of railroad men throughout the country, as well as the entire electrical fraternity, has been centered on the progress of the undertaking, and each step has been carefully noted.

This may be accounted for by the fact that the success or failure of the present enterprise is expected to have an important bearing on the future of railroading, and interests are at stake far outweighing anything that has transpired of recent years.

Everything points towards electricity as the motive power of the future, and the rapid development of the suburban electric roads, and their importance as a competing factor, have commanded the attention of railroad men for some time past in a manner not to be ignored.

President Clark, of the New York, New Haven & Hartford Railroad system, has long been an interested student of this development, and is probably as well posted on the merits

of electricity as any railroad man in the country.

The equipment of an electrical trunk line between New York and Boston is one of the possibilities of the future, and it was mainly to demonstrate the entire feasibility of this project that the present work was undertaken.

The Nantasket Beach branch is admirably adapted to the purpose, as within its seven miles of length are condensed about all the difficulties to be overcome in railroading, namely, many sharp curves and heavy grades. An idea of what the line offers in these two respects may be gathered from the fact that of the total length of seven miles, 4.4 miles is curve. There are 20 curves on the line altogether, the sharpest one of which is 10 degrees.

The heaviest grade is in the vicinity of the Old Colony House terminus, or what is now known as Nantasket Junction, where the grade is 34 feet to the mile. No pains have been spared to make every detail of the construction work as perfect as possible, and many new features have been introduced which are decided improvements over past methods.

The road is double track throughout its entire length, and is constructed the same as any first-class steam road. The rails are of the regular "T" type, four and a half inches high and weighing 78 pounds to the yard. They are laid 15 feet apart from center to center, and heavily ballasted.

The poles supporting the feed wires and trolley cross arms are set between the tracks. They are of Southern pine, painted white and are 30 feet in height, tapering from 12x14 inches at the butt to 10x12 inches at the top. They are placed from 60 to 90 feet apart, the shortest distances being on the curves. Each pole is surmounted by an iron cap grooved in the top to receive the feed wires, which are six in number, and laid side by side. These feed wires are something radically new, being cables of bare, stranded copper wire of 500,000 circular mils each.

The cross arms supporting the trolley wires are composed of two 2x3-inch iron angles bolted across the post, one on each side, and bent and securely fastened at the ends. The trolley wire itself is also of novel construction, being somewhat in the shape of a figure 8. The lower part is somewhat larger than the upper, and the clip from the cross arm fits securely around the upper section, leaving a smooth and unbroken surface for the contact of the trolley wheel. The trolley wire is of 433,000 circular mils capacity.

A very good general idea of the overhead construction may be obtained from the illustration, Fig. 2, which shows a section of the line looking from the power house towards Nantasket.

The heavy motor cars, which are particularly intended for express service, are in the form of combination baggage cars, as will be seen from the accompanying illustration, Fig. 1, and will draw a train of the usual size.

They are equipped with from two to four motors each of the General Electric 2,000 type. They are built extra heavy to secure traction power, weighing about 60,000 pounds, and

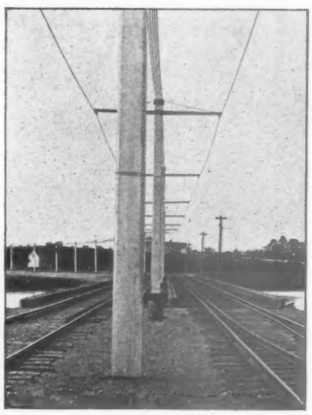

FIG. 2.—SECTION OF OVERHEAD CONSTRUCTION, LOOKING FROM POWER STATION TOWARD NANTASKET.

have a draw-bar pull of 4,000 and 8,000 pounds.

Each car is supplied with a General Electric series parallel controller, and equipped with Westinghouse air-brakes, operated by compressed air. They are also fitted with a chime whistle operated in the same manner.

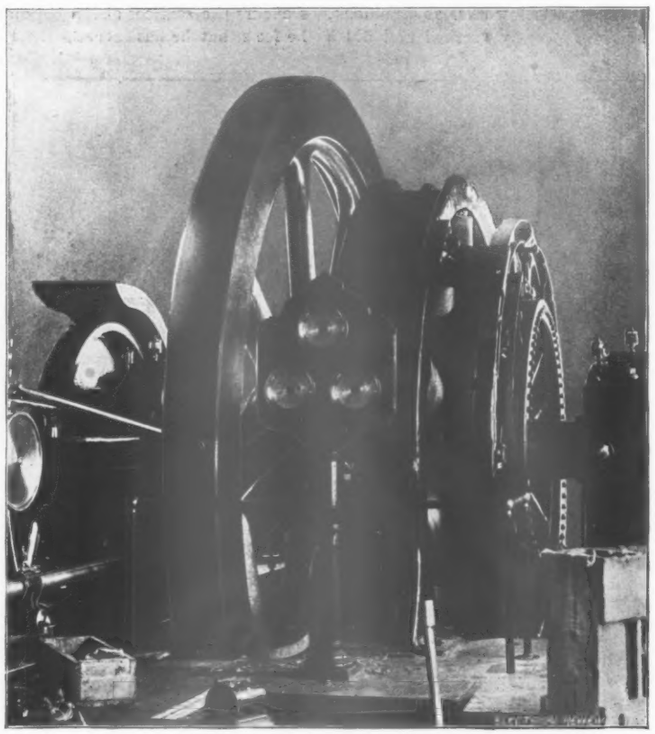

FIG. 3.—ONE OF THE GENERATORS IN THE POWER STATION OF THE NANTASKET BEACH LINE.

Outside of the express service the rolling stock consists principally of open cars equipped with their own motors.

The power house, which is a fine brick structure 83 x 110 feet, is located about midway between Nantasket Junction and the Beach. It is constructed in the most substantial manner and is virtually two separate buildings, the engine and boiler rooms being divided by a 24-inch wall.

Current is furnished at a pressure of 700 volts by two generators of 1,500 horse-power each, built by the General Electric Company and direct connected to two tandem compound Green-Corliss engines, especially designed for the work in hand. In connection with the generators they form a splendid unit, the generators being 10 feet high and the fly-wheel of the engine 18 feet in diameter and weighing 64,000 pounds. A traveling crane, with a 53-foot span, is one of the features of the engine room.

The boiler room, which is on a much lower level, contains two banks of four boilers each, giving a steam capacity of 2,800 horse-power. The boilers are of the horizontal flue type, 72 feet in diameter and 19 feet long with 140 three-inch tubes. The chimney is 13 feet in diameter at the base and 115 feet in height.

With this brief outline of the details of construction in mind, it will be interesting to note the success of the innovation from a financial standpoint. The expense of the equipment has been very heavy, but, aside from the importance of the project from an experimental point of view, it will doubtless prove a well paying investment.

Trains will run on a frequent schedule and preparations have been made for handling immense crowds of transient visitors. The novelty of the thing, together with the five-cent fares which will go into operation with the opening of the line, will draw big crowds, especially as the road runs through a picturesque section, and, for the greater part of its length, directly along the shore.

Ample yard and station facilities have been provided, this portion of the construction being under the charge of E. E. Pratt, Superintendent of Buildings, and personally supervised by J. Frank Vinal.

The road was formally opened to the public on Sunday, June 30. Previously a trial trip for the benefit of the officers of the road was made and the entire success of the installation thoroughly demonstrated.

This run was made at night, the party comprising only officials of the road, and the idea being to give a test of speed. Col. N. H. Heft, formerly president of the Bridgeport Traction Company and now superintendent of electrical construction for the Consolidated, was at the throttle, and under his manipulation the car reached a speed which tested the nerves of his passengers.

It was estimated that a portion of the run was made at a speed of 80 miles an hour, and a hot box was the only thing which prevented a still higher figure, as, when the current was turned off, there were still five notches to spare on the controller, and the momentum acquired carried the car two miles further at a speed of nearly 50 miles an hour.

On June 25 another test of the equipment was made with the object of showing its capacity for hauling freight. Motor car No. 2,500 successfully pushed and hauled 16 freight cars containing between 450 and 500 tons of freight at a speed of 25 miles an hour. From the standpoint of practical railroading, this test was of far greater value than the speed test mentioned above. The motor car handled this load without effort and its limit of capacity was not reached. The trial satisfied the officers of the road that the electrical equipment was alike practical for passenger and freight service.

The officials of the Consolidated road deserve credit for their courage in carrying out their convictions, and Third Engineer Curtis and his assistant, Mr. Pearson, as well as Colonel Heft, have added to their reputations by the very able manner in which they have brought their work to so successful an issue.

The official opening of the Nantasket Beach Electric Road occurred on Thursday, June 27, when a special train left the Old Colony depot bearing a large number of officials and newspaper men, guests of Superintendent Sanborn, on a visit of inspection. The daily press of the State was very largely represented, but strange as it may appear, considering the interest of the event from an electrical standpoint, the ELECTRICAL REVIEW was the only technical journal represented.

The start was made at 11.55 A. M., and Nantasket Junction, where the electrical equipment begins, was reached at 12.30. Here motor car No. 2502, known as the electrical "flyer," from its record run of last week, when a speed of 80 miles an hour was reached with ease, was awaiting the party with a long train of open cars, but owing to the heavy rain, which was falling at the time, the idea of making the run in open

cars was abandoned, and the motor car was coupled to the Boston special.

Col. N. H. Heft, electrical engineer of the road, climbed into a rubber coat and took his place at the controller on the front platform, and with a preliminary blast of the whistle and one or two strokes of the immense gong, the first passenger train over the new line glided smoothly off.

The run to the power house was made in a very few minutes, and here a siding was taken to afford the guests an opportunity of going over the station. Just after the special had come to a stop, a heavy rumbling was heard further up the line, and a loaded gravel train, consisting of 20 cars and a caboose, and drawn by another of the new motor cars went spinning by on its way to Nantasket, where additional side tracks are being laid and filled in. The heavy train thundering by under such circumstances was a novel sight and a powerful object lesson of the railroading of the future.

After the power house had been inspected, and the ponderous machinery, both steam and electrical, duly admired, the special was again boarded and quickly run to Nantasket, where a short stop was made to pick up some additional passengers. From here the run was continued to the terminus at Hull, where lunch was served in the Hotel Pemberton. Between Nantasket and Hull the road winds along the shore, following the beach from the ocean side, where the breakers dash almost to the tracks, to the placid waters of the inner bay. The scenery is very fine, the view from one side showing the green fields and trees of the peninsula, and beyond, the blue expanse of the bay dotted with pleasure craft of all descriptions, and on the other the open sea and the main gateway to Boston Harbor, guarded by the towering white pile of Boston Light and protected by the bristling guns of Fort Warren.

After lunch the party again resumed their seats in the train, and with the exception of a short stop at Nantasket while the local photographer got in his fine work, the run to the junction was made without interruption. Here the visitors said good-bye to Colonel Heft, who remained with his "motor," while an ordinary every-day locomotive hauled the train into Boston.

The trial trip was a pronounced success in every way, not the slightest hitch occurring from start to finish. The new system received well merited praise on all sides.

Nearly 100 guests partook of the hospitality of the company, and prominent among the officials present were A. C. Kendall, General Passenger Agent, Boston; C. Peter Clark, General Freight Agent, Geo. L. Conner, Passenger Traffic Manager, New Haven; Geo. S. Marrill, Chief Engineer, Boston; E. H. Bryant, Road Master, Boston; A. W. Martin, Acting General Superintendent, Boston; J. L. Andrews, Acting Superintendent Motive Power, New Haven; Geo. T. Taylor, Acting Superintendent, Worcester Division; E. P. Dawley, Division Engineer, Providence; E. E. Pratt, Superintendent of Buildings, New Haven; Wm. P. Appleyard, General Foreman Car Department, New Haven; I. B. Goodrich, Chief Clerk Motive Power Department, New Haven; A. L. Achley, Superintendent Taunton, Division; T. W. Hoogs, Secretary to 3d Vice-President, Boston; R. W. Husted, Purchasing Agent, Boston; T. H. Soule, General Car Inspector, New Haven; J. H. French, Superintendent Cape Cod Division, Hyannis, Mass.; A. H. Grovenor, Superintendent Union Freight Railroad, J. B. Gardner, Superintendent Stonington Division, Providence; I. N. Marshall, Superintendent Narragansett Division, South Framingham; F. B. Bertine, Auditor of Passenger Receipts, New Haven; Gorham E. Stamford, Ticket Receiver and Company's Representative, Boston; F. H. Crane, Superintendent Parlor and Sleeping Cars, New York; A. A. Maxwell, Claim Attorney, Boston; C. A. McAlpine, Superintendent Providence Division, Boston; Walter Wright, Chief Train Dispatcher, Plymouth Division, Boston; General W. W. Blackmar, Nantasket Steamboat Company, Boston; and J. C. Sanborn, Superintendent Plymouth Division, Boston, on whose invitation the guests assembled.

The electrical representatives made up in activity what they lacked in numbers, and consisted of C. C. Pierce, special agent railway department General Electric Company, Boston; C. B. Davis, New England Manager General Electric Company, Boston; John McGhie, Advertising Manager General Electric Company, New York; and H. G. Tuckerman, New England Manager ELECTRICAL REVIEW, Boston.

Among the representatives of the daily press were to be seen Jno. A. Hess, of the Providence *Journal*; Col. J. Armoy Knox, Brockton *Daily News*; E. E. Edwards, Boston *Transcript*; R. J. Silbert, Boston *Daily Standard*; Frank L. Sweet, Providence *News*; Jos. F. Travers, Boston *Courier*; Walter Powell Stevens, Fall River *Evening News*; Z. W. Pease, New Bedford *Mercury*; Hubert T. Jenkins, Boston *Daily Traveler*; W. T. Greenough, *Daily Gazette*; Chas. F. Waldo Archer, Boston *Journal*; Fred E. Kray, Boston *Advertiser*; J. S. Kuler, Boston *Herald*; and Robert Kent James, Boston *Budget*.

The first regularly scheduled passenger train on the Nantasket line left the yard at Nantasket Junction at 7.35 A. M., June 30, on its way to Pemberton. A large number of people were carried during the day and everything worked smoothly.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

TWELFTH GENERAL MEETING AND NINETY-SIXTH CONSECUTIVE MEETING HELD AT NIAGARA FALLS, N. Y., JUNE 25 TO 28—A REPRESENTATIVE ATTENDANCE NUMBERING OVER 250—VISIT TO THE GREAT POWER HOUSE—INTERESTING PAPERS READ.

One of the most successful and interesting meetings ever held by the American Institute of Electrical Engineers was that which occurred last week at the Cataract House, Niagara Falls. Over 250 people were in attendance, and Secretary Pope secured the names of 200 on his register. These appear elsewhere in this issue of the ELECTRICAL REVIEW. The programme was carried through on time, with but very few changes from the published order of procedure. Through the efforts of *Electric Power*, a photograph of the attendants at the meeting was secured. The picture is reproduced herewith.

MEMBERS AND GUESTS ATTENDING THE MEETING OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, NIAGARA FALLS, N. Y., JUNE 27, 1895.

Interest in the D'Arsonval Resuscitation Method.

TO THE EDITOR OF ELECTRICAL REVIEW:

Noticing in the last REVIEW that you would send the ELECTRICAL REVIEW pamphlet for the resuscitation of persons shocked by electricity, I take the liberty of inclosing stamp for the same.

Please send as soon as possible, for in my experience I have frequently been where any such information would have been very handy.

I take great pleasure in your valuable paper and look each number over with a great deal of interest, for there is much of great value even for a beginner.

Yours respectfully,
R. W. CRAWFORD.

Grand Rapids, Mich., June 27, 1895.

An exchange reports that an Irish conductor on a trolley car called out to the passengers standing in the aisle: "Will thim in front plaze to move up, so that thim behind can take the places of thim in front, an' lave room for thim who are nayther in front or behind?"

The sessions were held in the ballroom of the hotel. The first paper on the programme for Tuesday morning was that by Walter E. Harrington, of Camden, N. J., on "Properties of Fuse Metals When Subjected to Short Circuits." The discussion was spirited. Then Charles Proteus Steinmetz, of Schenectady, N. Y., read the first of his two papers. This was entitled, "Theory of the General Alternating Current Transformer." Clarence E. Gifford, of Jamestown, N. Y., closed the session with his paper on "Location of Grounds in Armatures, Fields, etc."

Tuesday afternoon was devoted to sightseeing and parties were made up to visit the power house of the Niagara Falls Power Company, the Pittsburgh Reduction Company's plant, the Carborundum Works and the station of the Niagara Falls & Buffalo Electric Light and Power Company. Of course the chief interest of the electrical engineers centered in the big generators of the

(Continued on page 7.)

The Lenox Avenue Underground Conduit Railway, New York City.

The first practical electrical underground conduit railway in this city is now in operation and will shortly be connected to the great cable traction system of the Metropolitan Traction Company. The public will then be able to travel from the Battery to 146th street with one transfer from the cable car to the electric car at West 108th street.

The underground electric system employed differs radically from all other systems of electric underground conduit railways, both as regards the construction of the conduit itself and the method of taking the current from the conductors for the motors. It has been operated more or less experimentally for the last month and its success has justified the sanguine predictions of the electricians and engineers who effected the installation.

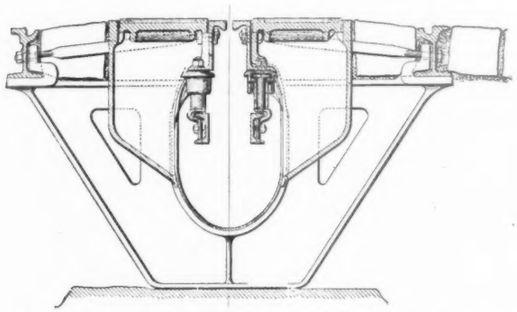

FIG. 1.—LENOX AVENUE UNDERGROUND CONDUIT RAILWAY, NEW YORK CITY.—SECTION OF CONDUIT SHOWING SUSPENSION OF CONDUCTOR BARS ON INSULATORS.

The introduction of this system upon the surface lines of New York city is the result of the determination of the Metropolitan Traction Company to give to New York a satisfactory electrical system of propulsion which would not be the subject of that peculiar popular prejudice which has acted to debar it from the advantages of the overhead trolley system. Consideration of the question resulted in the selection of a conduit system designed and manufactured by the General Electric Company, and the long stretch of road on Lenox avenue was chosen as the scene of the experiment.

In formulating the project the traction company proceeded upon the most conservative lines and determined to reduce the consequences of failure to the minimum of damage which would inevitably arise from any stoppage in the service. The plan, therefore, contemplated the construction of the line as if for a cable road, in order that, should the electrical system prove unsuccessful, the electrical portion could be taken out and the cables and pulleys of a regular cable system introduced into the conduit without loss of time and at comparatively small expense. Upon this basis construction was commenced and no pains and expense have been omitted to render the installation and operation successful.

The Lenox avenue line is a double-track road, starting at the car house at 146th street and running directly south to 116th street, into which it turns and proceeds as far west as Manhattan avenue; it turns here and runs as far south as 108th street, along which it is carried to the junction of that street and Columbus avenue. The district which this line will serve is at present somewhat sparsely settled, but the facilities of transit which it will afford will probably result in the rapid development of a new residence section for New Yorkers both on this and the other side of the Harlem.

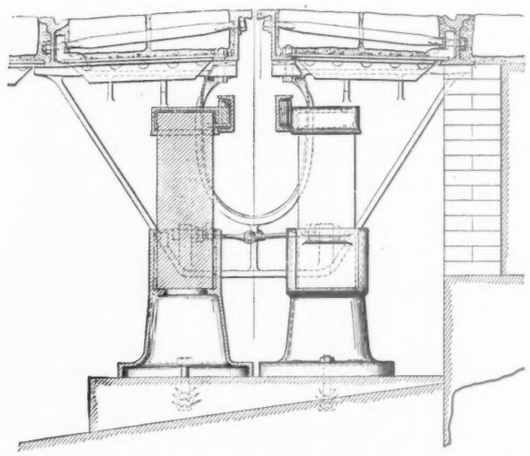

FIG. 2.—SECTIONAL VIEW OF LENOX AVENUE CONDUIT, SHOWING CONDUCTOR BARS SUPPORTED ON SOAPSTONE PILLARS.

The power house is a temporary frame structure with a sheathing of corrugated sheet iron, located on 146th street a few yards west of Lenox avenue. The present power plant consists of two 650 horse-power engines and two 400-kilowatt generators. Steam is supplied from two water-tube boilers, arranged in one battery. Each has a rated capacity of 250 horse-power, furnishing steam at 120 pounds. The engines are horizontal cross-compound Allis-Corliss machines, which during the experimental trips will run non-condensing. All the steam piping is placed beneath the floor of the engine room. To each of the engines is coupled a General Electric 400-kilowatt generator of standard construction, but wound for 350 volts, instead of 500 volts as is the usual practice in railway work. This machine is placed between the high and low pressure sides of the engines.

From the generators the cables run beneath the switchboard to a subway, under the sidewalk on 146th street, extending as far as Lenox avenue, where they are introduced into the five-inch iron pipes running parallel with the conduit. For the present the line will be operated directly from the power house, but the feed wires will probably be placed in the pipes and will be tapped into the conductor at the necessary points. This line will then be divided up into sections and its general operation thereby greatly facilitated.

The construction of the underground contact system is simplicity itself. The plough suspended from the car truck passes through the slot in the center of the track and presses against the flat surfaces of two iron conductors running the entire length of the conduit. Each of these conductors is placed three inches on each side away from the center of the slot to avoid deleterious effects of any drip which would otherwise reach them, and are of channel iron four inches deep and 30 feet long. They are suspended from the ceiling of the conduit by means of insulators devised for this especial purpose, and are at a depth of 13 inches below the conduit slot. Each conductor is sufficiently rigid to require suspension at the ends and centers only. The ends being located in the manholes and handholes being placed at the centers, inspection and repair are rendered comparatively easy. The conductors are bonded to each other by stranded copper wire securely riveted into the web of the metal.

A modification of this system of suspension of the conductors is introduced for a length of about 100 yards of single track on 116th street between Lenox and Seventh avenues. This is known as the pedestal method of support. At the manholes, instead of insulators suspended from the ceiling of the conduit, the conductors are supported by a soapstone pillar. The channel-bar conductors in this case are five inches deep and are set 12 inches below the slot. The soapstone pillars are provided with iron caps furnished with brackets to which the conductors are bolted, and continuous connection is secured by means of a bond of flat copper strips riveted to the webs. The soapstone blocks are set in iron bases erected in the manholes.

Every twelfth manhole is connected with the power house by telephone; quick break switches are located at intervals in these manholes, in order that any section of the line may be cut out in case of trouble or accident. At the track switches each conductor is provided with a flaring nose to facilitate the entrance of the plough into the conductors. The manholes in which the insulators are placed are four feet four inches in depth, four feet in length and 14 feet five and one-half inches in width, that is, the entire distance of the two tracks. They are constructed of brick with eight-inch walls that rest on concrete foundations. The floors are laid with six inches of concrete and are provided with drains for carrying off water. With this provision for drainage no trouble from water in the conduit will, it is believed, be experienced. The conduit was built along the grade of the street but with sufficient pitch to permit any water flowing into the conduit to find its way into the manholes, located every 30 feet, and thence into the sewers.

FIG. 3.—PLOUGH OR UNDERGROUND CONTACT USED ON LENOX AVENUE LINE.

The current does not return by means of the rails as is usually the case with the overhead trolley. This is a distinct feature and advantage of the new system. Each conductor forms one side of the working circuit, the current is fed into the positive conductor and returns over the other or negative conductor. The current merely rises on one side of the plough, passes through the controllers into the motors, and after performing its duty returns by the other side to the opposite or negative conductor.

The plough or traveling contact arrangement is also essentially novel. It consists of two pieces of iron, one on each side of the plough, supported on spring leaves, which cause them to press outwardly against the two conductors. The plough is suspended from a longitudinal bar bolted to cross beams set upon the truck, and is

constructed of two sheets of steel each laid upon a plate of fibre. The two sheets of fibre are then brought together enclosing strip copper conductors connected at the top to the motor cables, and at the bottom riveted to two other pieces of sheet steel. These run on each side of the plough and serve as supports for the hinges, which carry the sliding contact pieces. A heavy sheet of fibre continues downward and serves to separate these contacts. The motors employed are the standard General Electric 800 machines, controlled by two-kilowatt controllers.

FIG. 4.—CAR USED ON LENOX AVENUE CONDUIT RAILWAY, NEW YORK CITY.

The cars are mounted on cable trucks and resemble those used on the Broadway line. They are lighted by nine incandescent lamps arranged in groups of three each. A car barn similar in construction to the power house has been built at the corner of 146th street and Lenox avenue. The building is provided with four tracks and has a storage capacity for about 20 cars. The tracks are provided with pits for the examination of the trolleys and motors.

It is claimed that this system offers a correct solution of affording electric traction on city streets without incurring any popular odium from what is called the trolley difficulty. Moreover, it is free from most of the so-called objectionable features so characteristic of other methods which have been attempted elsewhere. Instead of a plough fitted with wheels running under or over wires strung in the conduit; instead of any of the other numerous and elaborate expedients to secure a workable underground conduit electrical system, the General Electric Company and the Metropolitan Traction have adopted one so simple in construction and operation as to excite surprise that it was never employed before. This new system is both cheap and easy to install, can be kept in repair at small cost and can be inspected without difficulty. It is an ideal system for surface traction in crowded cities.

It is stated that in case the operation of the electric conduit system proves successful, the power will be increased by the addition of three direct-connected units of 1,500 horse-power each, making the total capacity of the station 5,000 horse-power. The present temporary structure will be replaced by a handsome brick building for a power plant, car house and repair shops. It will be built on the west side of Lenox avenue, on which it will extend 200 feet, and its depth will be 550 feet. It will be two stories in height, constructed of a steel skeleton, enclosing brick walls and will be fireproof. The car house will have a capacity for about 350 cars. The offices of the receivers and starters, as well as the waiting room for conductors and motormen, will be located at the corner of 146th street. The car house will be provided with two large elevators, which will be operated by electricity. Ample provision has been made on the ground floor for repair shops and rooms for the engineers and firemen. The superintendent's office and a large reading room for the employés will be arranged on the second floor. In the tower on the third floor accommodations will be provided for the electricians of the station.

The introduction of this system in New York, where the crying need for rapid transit is almost equaled by the determination not to admit the overhead trolley, is only a start. Its satisfactory operation, safety and economy, when compared with cable or horse traction, will probably result in its general adoption upon the surface roads and another step toward real rapid transit will be made.

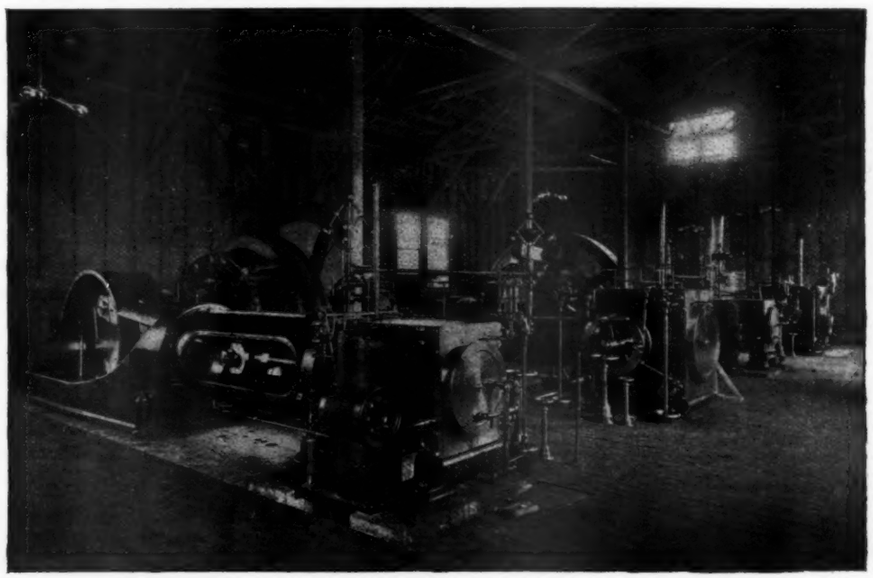

FIG. 5.—INTERIOR VIEW OF POWER STATION, LENOX AVENUE CONDUIT RAILWAY, NEW YORK CITY.

OBITUARY.

Alton J. Shaw, president of the Shaw Electric Crane Company, died on June 22 of peritonitis, after an illness of four days at his home in Muskegon, Mich. Mr. Shaw was 35 years old and leaves a wife and daughter.

TELEPHONE NEWS AND COMMENT.

The directors of the Erie Telegraph and Telephone Company filled the vacancy on their board caused by the death of ex-Governor Weston, of Manchester, N. H., by the unanimous election of Chas. S. Tuckerman, vice-president and treasurer of the Old Colony Trust Company, of Boston.

The output of the American Bell Telephone Company for the month ending June 20 was as follows:

	1895	1894	Increase.
Gross output	16,753	9,126	7,627
Returned	7,425	6,316	1,109
Net output	9,328	2,810	6,518
Since December 20:			
	1894-5	1893-4	Increase.
Gross output	85,059	41,025	44,034
Returned	39,608	34,695	4,913
Net output	45,451	6,330	39,121
Total outstanding	627,957	572,821	55,136

At a special meeting of the American Bell Telephone Company on June 26 the stockholders voted to increase the capital stock of the company by $1,000,000 or 10,000 shares, making total capital stock $21,500,000. President Hudson stated that for the work now in hand the company needs between $1,500,000 and $2,000,000, mostly construction requirements of the Long-Distance Telephone Company and the sub-companies, of which the American Bell Telephone Company has to pay its proportion.

At the annual meeting of the stockholders of the Southwestern Telephone Company, held at Durango, Colo., J. H. Ward, of Bristol, Conn., was elected president; Geo. W. Larimer, Wichita, Kas., vice-president; O. D. Weedham, Durango, treasurer, and C. J. O'Keeffe, Durango, secretary and manager. It was decided to increase the capital stock of the company and extend the business throughout the entire San Juan country. The company will shortly be in the market for more telephones and construction material.

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SPECIAL NOTICE TO ADVERTISERS.

CHANGES for advertisements must be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week.

NEW YORK, JULY 3, 1895.

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This Fourth of July is a good opportunity to fittingly celebrate the return of prosperity. Electrical men should take a place near the head of the table on this occasion.

So eminent an authority as Mr. Charles H. Cramp, the great shipbuilder, has recognized the idea that the yacht of the future will be driven, heated, lighted and otherwise served by electricity. He thinks "her propeller might be driven by electricity, not generated from the friction of her own passage through waves, but certainly obtainable independent of any power station."

The meeting of the American Institute of Electrical Engineers at Niagara Falls last week was successful and very interesting. The power house of the Niagara Falls Power Company and Dr. Duncan's inaugural address were features of unusual interest to every one. Mr. Stilwell's lecture formed a fitting complement to the power house visit and was greatly enjoyed.

The annexation of new territory north of New York city has caused trouble for the Union Railway Company which operates a trolley road in that locality. The new territory is now within the corporate limits of New York city, and the anti-annexationists object to paying more than one fare to ride from any suburb in the new district to One Hundred and Twenty-ninth street and Third avenue. Right seems to be with the public, as, we believe, only one fare can be legally collected for a continuous ride within the city limits.

We give our readers, in this issue of the ELECTRICAL REVIEW, an interesting account of the electrical equipment of seven miles of steam railway at Nantasket Beach, Mass. Every preliminary test of the new equipment was successful and it would seem that a new era in railroading has dawned. The actual test of daily operation will be awaited with much interest, though as to the bare fact of its being a success there is not the slightest room for doubt. The next step will be the gradual equipment of all branch lines where frequent trains and cheap fares are required, and from these spurs the new order of things will spread. A limitless field lies open to the electrical workers of the country, and the first step being taken, the advantage should be followed up promptly and effectively. The railroads will not be slow to adopt what is so eminently to their advantage, and the element of doubt being eliminated, the rest is plain sailing.

WALL STREET AND THE ELECTRICAL STOCK MARKET.

Prices of stocks and bonds reacted during the latter half of the week. This was due to a panic in the industrials which was precipitated by the execution of stop orders placed slightly below the market by small speculators. Chicago Gas had a break of some 16 points this week and sugar a similar amount from the high point of last week. This naturally weakened the entire list. The business news was all favorable, and in this respect was out of joint with speculation. Trunk line rates have been restored. The anthracite coal trade has been promised a speedy rehabilitation and business of all descriptions continues to improve.

Wall street was greatly interested during the week in the reported preparations for a battle royal between the Bell Telephone Company and Western Union. These two concerns have a form of contract not to trespass on each other's territory. This, it is understood, expires next year. Western Union has a substantial interest in the Metropolitan Telephone Company and, it is said, has recently increased it, but it is not thought probable that it has secured control. The telephone company has been a thorn in Western Union flesh for some little time and up to date appears to have the best of the situation. It and its associates have been leasing private wires between New York and Chicago to Wall street houses at something like $18,000 per year as against $25,000, the amount charged by Western Union. Another form of annoyance has been sub-leasing of the New York electrical subways to competitors of Western Union. In the last year or two at least one financial news agency has thus been able to compete with the Western Union's ticker service and several district messenger companies to operate in opposition to the American District Telegraph Company—virtually a part of the Western Union. From these and other facts of a similar nature it is not surprising that Western Union should seek to smash or to control its powerful competitor. Well informed interests believe that it will not succeed in doing either. Still there is no open warfare, and probably won't be until the contract expires next year.

The Bell company's stockholders authorized an increase of $1,000,000 in the capital stock to $21,500,000. Money is to be used in making extensions and will be followed by other issues of stocks for a similar purpose until the $28,500,000 additional capital authorized is used up, at which time the company will be found to have as good or even better network of wires over the country than has Western Union with twice as much capital. It is very easy to attach a telegraph instrument to a long-distance telephone wire, as is demonstrated by the leased Chicago wires. It begins to look as if Western Union in the next few years will meet a competitor, like the Postal, which it can neither freeze out nor buy up.

BAIN.

New York, June 29, 1895.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

(*Continued from page 5.*)

Niagara Falls Power Company. There are two of these now in place and one was put in operation on several occasions for the visitors. This giant generator was once speeded up to 300 revolutions per minute and developed 5,025 horse-power. Every one was pleased with the delicate and perfect working of the governor used to regulate the flow of water to the turbine. This was designed by the well-known Swiss firm of Faesch & Piccard and in the opinion of many is the best governor of its kind yet placed on the market. A load of 3,000 horse-power has been thrown off the big generator with a gain in speed of but a few revolutions. This immense machine can be brought to a stop in 30 seconds.

A feature of the power house is the switchboard platform which is elevated about 10 feet above the floor and is located in the center of the room. When the equipment is complete there will be 10 of these 5,000 horse-power generators on each side of the room, making 20 in all capable of delivering 100,000 horse-power. The gates controlling the flow of water from the canal are operated by electric motors located on brackets above the power house floor. An immense electric crane is also in service.

At one end of the house, high above the floor, is an oil tank holding probably 50 barrels of oil which supplies the oiling system. Under the switchboard platform are located the main switches, carrying 2,000 volts and operated by compressed air. These are enclosed by glass doors under lock and key. Before the current reaches the switchboard it is transformed so that 100 volts is the highest tension handled on the platform. A very handsome and compact panel board will be used, each panel containing the usual measuring instruments, including a new type Shallenberger meter called the "Niagara." The main switches will be operated from the platform by a very simple system of levers and valve wheels controlling the supply of compressed air. The oil pumps and air compressors are operated by the "seepage" of an underground flow of water encountered in the construction of the power house. A feature of the big generators is a series of copper ventilators located on top of the revolving fields. They are semi-circular in form, and so placed that they revolve backwards, as it were, causing a suction of air up through the machine, which gives excellent ventilation. A very loud and peculiar siren effect occurs at the turbines, but is not noticeable on the power house floor.

President Duncan read his inaugural address at the Tuesday evening session. It is entitled "The Substitution of Electricity for Steam in Railway Practice" and will be found in another part of this issue of the ELECTRICAL REVIEW. Its conservative tone led a friend to jokingly accuse Dr. Duncan of "being more a steam man than an electrical man." But this is a subject in which it is well to temper enthusiasm with intelligent conservatism. Professor Thomson at this session read his paper on "Compounding Dynamos by Armature Reaction."

Wednesday morning was devoted to reading Mr. Steinmetz's paper on "Some Features of Alternating Current Systems;" "Electric Power in Factories," by Dr. Francis B. Crocker and Messrs. Benedikt and Ormsbee; and "Some Observations on a Direct-Connected 300-kilowatt Monocyclic Alternator" by Professor Dugald C. Jackson and S. B. Fortenbaugh.

A delightful trip was taken Wednesday afternoon on a special train of the Niagara Falls Park and River Railway. Stops were made on the Canadian side at Queenstown, Whirlpool, Table Rock, Chippewa, etc. In the evening Dr. C. E. Emery read a paper on "The Cost of Steam Power."

Dr. Albert M. Bleile's paper "On the Cause of Death in Electric Shock" opened the session Thursday morning. Professor Thomson's discussion was extremely interesting and elicited applause. "Long-Distance Power Transmission at 10,000 Volts" was read by George Herbert Winslow. The plant at Pomona, Cal., was described in this paper.

Thursday afternoon was spent in individual trips about the Falls. A popular place was the observation tower, 300 feet high, equipped with two electric elevators. From the top the whole Niagara region was seen and a dim view of Buffalo and Toronto could be had. Historic Lundy's Lane was prominently in sight. While some of the attendants were taking in the sights others were listening to Dr. Emery's paper on "Alternating Current Curves."

Thursday evening's *piece de resistance* was Mr. L. B. Stilwell's excellent address entitled "Work of the Westinghouse Electric and Manufacturing Company for the Cataract Construction Company." This was illustrated with lantern slides and was an abstract of a report made for the construction company's archives. Franklin Leonard Pope's paper, "Notes on the Reconstruction of a Small Central station plant," was down for Thursday evening and the programme closed with W. L. R. Emmett's paper, "Existing Commercial Applications of Electrical Power from Niagara Falls," which occupied the programme for Friday morning.

The attendants, both members and guests, were provided with neat badges bearing the Institute's emblem, which entitled the wearers to many privileges. Even the Niagara Falls hackmen became humble and reasonable at sight of these badges.

LIST OF MEMBERS AND GUESTS.

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Miss E. Gumming, Philadelphia, Pa.
E. W. Rice, Jr., Schenectady, N. Y.
Chas. Plumb, Buffalo, N. Y.
Miss A. F. Plumb, Buffalo, N. Y.
Reginald A. Fessenden, Allegheny, Pa.
J. Jordan, Vienna.
Robt. McC. Lloyd, N. Y.
H. B. Sweet, Memphis, Tenn.
C. P. Poole, New York.
W. D. Weaver, New York.
Jules Ueher, New York.
Thos. H. Feary, Buffalo.
E. P. Coleman, Decatur, Ill.
H. W. Fisher, Pittsburgh, Pa.
J. R. Haskin, Niagara Falls.
Stephen L. Coles, ELECTRICAL REVIEW, New York.
Herbert Lloyd, Philadelphia.
Miss Maud Noble, Philadelphia.
E. W. Rice, Jr., Schenectady.

PERSONAL.

Mr. G. F. Evans has succeeded to the business of the Evans Friction Cone Company and will hereafter conduct it at the old address, 85 Water street, Boston.

The Electrical Engineering Company, of Minneapolis, Minn., have been appointed the Northwestern representatives of the Siemens & Halske Electric Company of America.

Max A. Berg has resigned the secretaryship of the Wallace Electric Company, of Chicago, to take effect from July 1. Mr. Berg will enjoy a well-earned rest and will probably be again associated with electrical work in the near future.

Mr. Henry Sachs has tendered his resignation as general manager of the Beacon Vacuum Pump and Electrical Company, of Boston, to take effect from July 1. Mr. Sachs has not yet made any definite arrangements for the future. His electrical friends and others who wish to communicate with him may address him at 21 Harcourt street, Boston.

Mr. R. T. McDonald, of the Fort Wayne Electric Corporation, is in receipt of scores of congratulations, in which the ELECTRICAL REVIEW cordially joins, over the dismissal of the indictments found against the officials of the Madison Square Bank, of New York, at the time he was vice-president. The District Attorney announced that after the most careful investigation nothing could be found that in the least implicated Mr. McDonald.

Pst! Boom! Ah! Look Out For The Stick!

An American flag, a sky rocket and a patriotic verse just received remind the electrical fraternity, as a Fourth of July greeting that there is but one American flag and one American Electrical Works, of Providence, R.I.

The Telephone Protective Association.

The Pittsburgh meeting of telephone manufacturers, as reported in the ELECTRICAL REVIEW last week, added several names to the executive committee and adjourned after a two-day session to meet early in September at Niagara Falls. The completed list of officers of this association is now as follows:

President—J. E. Keelyn, Chicago.

Vice-presidents—J. R. Johnson, Baltimore, and S. J. Tunbridge, Utica.

Secretary and Treasurer—Paul W. Bossart, St. Paul.

Directors—Officers *ex-officio*, and E. S. Wallace, New York; P. C. Burns, Kokomo, Ind.; J. G. Ihmsen, Pittsburgh; A. F. Boardman, Boston; E. A. Catlin, Richmond; P. L. Spooner, Madison, Wis.; J. D. Randall, Memphis; E. B. Seely and M. Kuhn, Philadelphia; Thos. McCoubray, New York; Frederic Harrington, Cleveland.

Executive Committee—J. E. Keelyn, J. R. Johnson, S. J. Tunbridge.

LATE NEWS CONDENSED.

Dr. Robert W. Buchanan, the wife poisoner, was executed by electricity at Sing Sing, N. Y., on July 1.

A successful test of the big electric locomotive for the Baltimore belt line tunnel was made on June 27. It was run through the tunnel several times hauling a steam locomotive at 20 miles an hour.

The application of the United Electric Securities Company, of Boston, for the appointment of a receiver for the Louisiana Electric Light and Power Company, of New Orleans, has been refused. The matter involved charges of mismanagement against Messrs. McDonald and Hart.

The ELECTRICAL REVIEW is informed by an officer of the General Electric Company that the Lake Street Elevated equipment contract calls for an expenditure of between $250,000 and $300,000 for electrical equipment alone. There will be 100 motors and 25 motor cars. The system is similar in every respect to that which is employed on the Metropolitan West Side Elevated.

The final incorporation papers of the Inter-Ocean Electric Railway Company of Chicago were granted on June 29. The company is organized primarily to construct and operate an elevated double-track electric railway between Chicago and New York. The company is capitalized for $200,000,000, and its life extends over 99 years. The names which appear upon the incorporation papers are John W. Hill, John Mayo Palmer, Parker Crittenden, James G. Hulse, Lysander Hill and Henry E. Beasley.

The assets of the Accumulator Company of New Jersey were sold in Philadelphia on June 27. The gross proceeds of the sale were $435,800, of which all but $700 was received from the sale of 18,000 shares of the Electric Storage Battery Company's stock which formed part of the assets. This entire block was purchased in the interest of the Accumulator Company's bondholders by a syndicate, which paid $24 per share for 17,100 shares, $27 per share for 100, and $27.50 per share for the balance.

The Cataract Construction Company on June 28 successfully transmitted 2,000 horse-power from the power house at Niagara Falls to the works of the Pittsburgh Reduction Company, three-quarters of a mile distant. Its course was first through the subway to the transformer building, where the alternating current, by passing through both static and rotary transformers, is changed to a direct current then sent to the factory. The machinery worked smoothly and the test was pronounced an entire success. In the power station were Mr. Stilwell, Mr. C. F. Scott, the electrician of the Westinghouse company; O. B. Shallenberger, the consulting engineer; Paul M. Lincoln, the engineer in charge of construction, and others of the Westinghouse force of engineers and electricians. The General Electric Company's corps were at the other end, including Prof. Elihu Thomson, Charles P. Steinmetz, S. Dana Greene, W. L. R. Emmet and others.

Half An Hour in a Modern Electrical Factory.

A representative of the ELECTRICAL REVIEW visited the new Westinghouse factory in East Pittsburgh last week. Thirty minutes was the time at his disposal between trains, and under intelligent guidance a quick run was made through the various departments of this admirably arranged establishment. The practical genius of Mr. George Westinghouse, Jr., and of his able assistant, Mr. Albert Schmid, has reduced to a science in point of convenience and efficiency the construction and arrangement of this great electrical factory. Electric power is the flexible force distributed through every department, and an underground electric railway was to be seen in constant use, handling with ease heavy carloads. This electric road is the one described in the ELECTRICAL REVIEW last week. The Tesla polyphase system is used throughout the factory. Two immense generators of 500 horse-power each were seen in operation, and two more were being put in place. The immense battery of boilers is so arranged that it can be conveniently doubled if required.

Electric cranes are used in the various departments. A view from the gallery in the main hall presents an interesting and inspiring scene to one at all attracted by the sight of machinery in motion and the music of whirring wheels.

Every employé seemed to know what to do and was doing it. No one at any point was noticed with an aimless air; all were busy and all apparently with their mind on their work. This is one of the sure signs of a well-managed establishment—that its head is an experienced and watchful one.

The accounting department, presided over by Auditor Ketchum, is another interesting scene. Everything here apparently moves like clock-work focusing to the auditor, whose quiet command of his force indicates the efficient executive. Back of this very large department are the rooms of the purchasing agent and numerous consulting rooms for visiting engineers and purchasers.

In the front on the same floor, the second, are the rooms of other officials, the treasurer, Mr. George Lewars, and Messrs. Schmid, Stillwell, Shallenberger, Scott and others.

The buildings at present cover about 23 acres, some 40 acres in all having been purchased by the Westinghouse company. A short distance beyond the factory are the works of the Westinghouse Air Brake Company. Conveniently in front the foundations of the Westinghouse Machine Works are being put in on a large scale. An attractive little club where the officials of the company lunch is within a few steps of the door.

An army of 3,500 persons enter this establishment every day, an automatic watchman's record noting the moment of arrival. It is safe to say that the payroll amounts to $45,000 per week.

Two special trains, morning and evening, carry the large force between the factory and Pittsburgh.

A specially constructed elevated railway brings the coal to the second floor for supplying the boilers through the automatic stokers.

At night the factory was seen from the Pennsylvania road lighted throughout and a large force of workmen were in evidence. Business is certainly good with the Westinghouse Electric and Manufacturing Company.

"THE SUBSTITUTION OF ELECTRICITY FOR STEAM IN RAILWAY PRACTICE."

INAUGURAL ADDRESS BY DR. LOUIS DUNCAN, A.I.E.E., NIAGARA FALLS, JUNE, 1895.

In an address delivered before this Institute in June, 1892, Mr. Frank J. Sprague spoke of the coming development of electricity as applied to railways, and outlined his views as to the direction of this development. In the last three years great extensions have been made in electrical transportation, and it seems well to review briefly the amount of these extensions and their direction. In this paper I shall consider electric traction as it stands at present and not the possibilities of the future.

In the last seven years electricity has largely taken the place of horses for tramway work, and it is now beginning to replace cables, although the latter have been recently installed at great expense. At first the lines were confined to the limits of towns and cities, but they have been extended first into the suburbs, and then to neighboring towns, and the extensions have brought them in competition with the steam roads. The reports of the earnings of the railroad companies in the United States show that after paying fixed charges only a small amount of the net profit remains to be applied to dividends on the stock. Any general decrease in the earnings, even if it is only a small percentage of the total amount, will wipe out the narrow margin that is now applied to dividends, and the absorption by the electrical lines of the local travel formerly conducted by the steam lines promises to do this. At first the managers of the larger steam roads ignored the growth of their electrical rivals, but the time has come when they can no longer ignore the decrease in the receipts from their local passenger travel, and they are beginning to face the difficulty and to carefully study the situation.

In this paper I will briefly take up the following questions:

1. Given a railroad system at present operated by steam; will it pay to change entirely to electricity, or to make a partial substitution, and how should the change be made?

2. If entirely new lines are to be built is it likely that it will pay to equip them electrically, and how should they be equipped?

3. I will describe the equipment of the B. & O. Tunnel plant and draw from it what morals I can.

In order that it should pay a railroad to make a change in its motive power, the effect of the change must be either to increase the receipts or decrease the expenses by an amount equal to the interest on the first of the change. That is, there should theoretically be such a gain; practically, the amount should be greater in order to justify the change, to take into account those elements not capable of exact calculation, and also the fact that an increase in the fixed charges of a road is a more serious matter than the mere amount of it, for although the average for a number of years might show a gain by the substitution of electricity in a bad year the increased fixed charge might cause difficulty.

There are two very distinct sides to the question of transportation, the passenger side and the freight side, and their requirements for good service are very different.

First, taking up the question of passenger travel. The receipts of a road are increased by running trains at short intervals and at high speeds, and this is a condition peculiarly favorable to electricity. On an electric line short trains equally distributed over the track give a greater station efficiency, and the lowest cost of equipment of both station and line. The cost of train service is somewhat greater, but is compensated by the saving in the other items.

The cost of hauling a given number of passengers between given points by steam is greatly increased when the number of trains is increased. The efficiency is less, and the cost of equipment and of train service is greater. Wellington states that doubling the number of engines for a given traffic increases the cost of transportation about 50%.

On the other hand, if we take up the question of freight traffic, the conditions of greatest economy are reached when trains of a maximum weight are hauled by a single locomotive. The tendency in late years has been in the direction of increasing the size of the locomotive, the capacity of the cars and the length of the trains. These changes have necessitated more solid and expensive road beds, heavier rails and general strengthening of bridges. The outlay has been enormous, but the decreased cost per ton mile for freight transportation has shown the wisdom of the change. On one of the larger roads which publishes careful yearly statistics, I find that the cost of transportation per ton mile in 1870 was 1.15 cent, and in 1890 .56 cent; on another road it was 1.9 cent in 1864 and .447 cent in 1893. The number of tons per train mile on the first road in 1870 was 103, while in 1890 it was 226. In attempting to carry on traffic of this kind by electrical locomotives operated from a central station, we find that we are at a great disadvantage because of the irregular service necessitated by the freight traffic and the unequal distribution of the load along the line. Suppose, for instance, that there were two stations supplying the line and that the traffic was uniformly distributed along it, then the capacity of each station would be one-half of the total required capacity. Suppose, however, that the entire traffic was concentrated in one train, then each station would have to have a capacity equal to the total power required for hauling the entire traffic, as the train would be first supplied from one station, and then from the other. The line also would have to have a capacity suitable for handling the total traffic. If a number of heavy trains were used, and the traffic was irregular and liable to be congested at one point, as in the case of freight service, then again the capacity of the stations would have to be greater than that required to supply one-half of the normal traffic. If we were to decide to transmit the current to a longer distance and to supply all the track from one station using transformer devices along the line, then the capacity of the station itself would only be that required for the normal traffic of the line, but the transformer devices would have to be sufficient to handle the maximum traffic of the section which they supplied, and would have to be given a capacity greatly in excess of their average load in order to supply this energy. We must distinctly bear in mind in considering the application of electricity to steam roads that any departure from a uniform distribution of load along the line will increase both the cost of equipment and the cost of operation.

In looking over the reports of the same road from which I have given freight statistics, I find that in 1870 the receipts per passenger mile were 2.09 cents, while the expenses were .59 cent. In 1890 the receipts were 1.09 cent, while the expenses were 1.47 cent. During this period the passengers per train mile have decreased from 79 to 59. Comparing these figures with those given for freight transportation, we find that the two types of traffic have gone in opposite directions in the period we have been considering. The amount of freight transported per train mile has more than doubled, and the expense has decreased more than one-half. The passengers per train mile, on the other hand, have decreased, and the expenses have changed only a slight amount, notwithstanding the greater economics that have been put in force in the interval. Passenger traffic has come in the direction in which electricity is the most economical for transportation; freight traffic, on the other hand, has gone in the direction where electricity becomes most costly. It might be argued that some new scheme for freight transportation by electricity might be used, but it would be difficult to devise any system more economical than that at present in use, and the great amount of through traffic on freight lines precludes the possibility of devising any system which differs radically from that at present in use. For instance, taking the figures from the records of the Pennsylvania Railroad for 1893, I find that the freight mileage of foreign cars on the lines of the Pennsylvania Road east of Pittsburgh is in round numbers, 370,000,000, while the freight mileage of home cars is 436,000,000, making almost 46% of the total mileage made by foreign cars. It would seem, then, impossible to change the present system of freight traffic without disorganizing the service and decreasing the freight revenue of the road. The importance of freight traffic is shown by the fact that the earnings from freight on all the roads in the United States is between two and one-half and three times as great as that for passenger traffic. The New York Central Railroad Company in 1892 received from their freight traffic $26,000,000, and from their passenger traffic $13,000,000. On the lines of the Pennsylvania Railroad east of Pittsburgh the freight receipts were $47,000,000 as against $17,000,000 for passenger receipts.

Suppose, then, the question comes up before the managers of a road as to whether they are to equip their lines to be operated entirely by electricity. It seems to me as matters now stand it will not pay trunk lines to change the method of operation for freight traffic, and the question to be considered would be the operating of the lines partly by steam and partly by electricity. Let us consider if it is possible to run the passenger service wholly or partly by electricity. Considering a two-track road doing a through as well as a local business, I think we can decide that, unless the case be an exceptional one, it will not pay to equip the

(Concluded on page 10.)

The Belfast, Ireland, Municipal Electric Station.

In the municipal electric lighting station at Belfast, Ireland, an interesting installation of gas engines has been made, a description of which may prove valuable to American electrical engineers. The plant was recently described in London *Lightning*, and we are indebted to *Progressive Age* for the accompanying illustration showing the interior of the station.

Belfast is a city of nominally only 280,000 inhabitants, but ranks only third amongst the ports of Great Britain, London and Liverpool alone exceeding her in amount of imports. It possesses five public parks, a free public library and art gallery, numerous public baths and other evidences of wise municipal expenditure, yet the lighting service has hitherto been disproportionately poor and the present station is the first fruit of a new and comprehensive plan for lighting the city by a series of central stations. The first one covers the central territory, devoted chiefly to business purposes, and among the establishments that have been fitted up for the light are the Theater Royal, the Royal Alhambra, the Ulster Bank and the Ulster Reform Club.

Interior View of the Belfast, Ireland, Municipal Electric Station.

The specifications for the electrical work were drawn by Professor Kennedy, who estimated that in that part of the city it would be amply sufficient to provide for 6,100 lamps alight at the same time. These lamps, he further estimated, would each use about 17.5 units of electricity per annum.

The works are situated on the site of an old tannery between Chapel Lane and Marquis street, there being an entrance from each of these thoroughfares. The entire length of the new structure from Chapel Lane to Marquis street is 185 feet. On the ground floor are the engineer's and general offices. On the first floor, reached by a flight of stone stairs, the meters are kept in a room on the right, while meter-testing will be carried on in a room on the left. The ascent of a few steps at the rear of the offices brings us to the switchboard gallery, eight feet six inches by 32 feet. Close by is the battery room —about 28 feet square—in which there are battery stands containing two secondary batteries of 63 cells each, of the 34 K. E. P. S. type. In these accumulators energy will be stored during the day, and from them light will be supplied at such times as the engines and dynamos are not working.

The engine and dynamo room is a single story building with a high roof, lighted from the top, and has a line of columns on the south side. There are four Siemens dynamos, each of 57½ kilowatts, capable of giving 240 amperes at a pressure of 240 volts, and two smaller dynamos, also supplied by Messrs. Siemens Bros., of 26½ kilowatts, with double-wound armatures and two commutators, can be run at either 110 or 220 volts. The latter are used as balancing machines and for charging the cells.

The gas engine plant supplied by Messrs. Dick, Kerr & Company, of Kilmarnock, is probably the largest installation of the kind in the world. It consists of four tandem-cylinder double-acting gas engines of 100 horse-power each and two single-cylinder double-acting gas engines of 50 horse-power each. The former are required to drive the four 57½-kilowatt dynamos above mentioned, and the latter for the charging machines. The chief interest lies in the tandem engines, which have been specially designed and built for this station. The two cylinders are in line and the pistons are secured to the same piston rod, which works through a cross-head and connecting rod on to a single crank, in the manner common to steam engines. The makers claim that this arrangement is simpler and more economical than the coupling side by side of two ordinary gas engines; the working parts are fewer and more easily got at, while the floor space required is only the width of an ordinary engine. The length of the tandem engine is no detriment, as the dynamo is placed near to the back cylinder and driven by ropes running along the back of the engine.

The running of these engines should be very regular, owing to there being one impulse for every half-revolution of the crank when running at full power. Since it is desirable to run steadily at light loads as well as at full load, a special governor has been designed, by means of which the power of the impulses is diminished to a fixed point (similar in effect to the automatic expansion gear on a steam engine), after which cutting out of the charges takes place, first at one end of the cylinder, then the other, and so on, until all four working ends are running idle. The engines run inward, so that the slack of the driving rope is on the top inside.

One difficulty connected with gas engine plants, that of starting, is ingeniously met by momentarily using one of the dynamos, driven as a motor by the storage cells, for this purpose, so that the engines are started by turning a switch on the switchboard.

The three-wire system of distribution has been adopted at a pressure of 110 volts, or 220 volts between the outer wires. It was originally intended that all the mains should be bare copper strips in culverts, except at street crossings, where insulated cable was to be used, but when the work was actually in hand it was found necessary to replace much of the strip by insulated cables. The cables used were insulated by vulcanized bitumen and heavily taped and braided to stand rough handling when being drawn into pipes. In any installation containing more than 50 eight-candle-power lamps, or their equivalent, or requiring a large and variable supply of current, or current for motive power, the corporation reserve to themselves the right of supplying at a pressure of 220 volts, with subdivided circuits of 110 volts each.

The particular circumstances which influenced the corporation in their choice of this system are worthy of special notice. The lightness of the day load and the large difference between the Winter and Summer demand rendered the use of batteries very desirable in order to economize labor and fuel during the time of light load. It was also considered to be a reason in favor of gas engines, since they can be started at any moment as required. It is intended that the lighting of the outlying districts, which are separated from the central district by a ring of territory devoted to industrial purposes which would buy very little light, should be carried out by means of sub-stations, with their own gas engines and batteries. The plan in effect amounts to distribution by gas pipes from the central gas works to the various sub-stations, and thence electrical distribution on the three-wire system from the batteries to the consumers. It is a decided departure from established custom and the result will be awaited with considerable interest, both by those connected with the industry and by prospective customers.

Niagara Falls Power.

The Buffalo, N. Y., Aldermen have not as yet granted the Niagara Falls Power Company a franchise for Buffalo, although meetings with this end in view have been held weekly for a month or more. At a meeting held on June 21, the power committee of the aldermen discussed with Secretary Rankine of the Niagara Falls Power Company the matter of running the city's waterworks and lighting the city. No agreement was reached and the meeting adjourned for two weeks.

Association of Edison Illuminating Companies.

The next convention of the Association of Edison Illuminating Companies will be held at Detroit, Mich., commencing Tuesday, August 13, 1895.

DR. DUNCAN'S INAUGURAL ADDRESS.

(*Concluded from Page 8.*)

main line electrically. It is necessary that the through express service be continued and that the freight service be continued, and an attempt to operate the local trains with the through trains could not be successful if there was any considerable amount of through traffic. With a four-track road the condition of affairs is somewhat different. If the road operates between cities acting as terminal points for all passenger traffic, as with some of the lines between Boston and New York, then by equipping all four tracks it would be possible to run express service at short intervals on two of the tracks, and on the other two tracks to run freight and local trains. At present it would not pay to use electric locomotives operated from a central station for the freight service, but the local service could be operated electrically; and as the speed of the local trains would be approximately equal to that of the freight, there need be no serious interference with the traffic. We would then have express passenger service working under favorable conditions—that is, with a number of trains evenly distributed, a local service operated under similar favorable conditions and with no interruption to the freight traffic. If the road, however, is to transport a considerable number of foreign cars as, for example, the New York Central or the Pennsylvania Railroad, then the condition of affairs for express service would not be so favorable, and the question of the equipment of the tracks for express service would have to be carefully considered. As far as the branch lines go, whether it would pay to partially or wholly substitute electricity for steam depends upon the local conditions. A long branch with a small amount of local traffic it would not pay to equip, but on a short branch with considerable passenger traffic and comparatively little freight traffic such equipment would pay. I find that in 1892 the total number of through passengers carried by the New York Central Road was 234,650, while the number of local passengers was 21,978,979. It will be seen that the through traffic is but a small percentage of the total number of passengers, and that the question of preserving the local traffic is of great importance. Now the greater part of this local traffic will, in the next few years, be taken by the electric roads paralleling the steam road, unless some effort is made either to control the electric roads or to give an equally good service between adjacent towns. This latter is possible, using the ordinary steam tracks only when the distances between towns are small and the amount of freight or through traffic is also small.

There are certain kinds of local traffic which the steam roads must, to a large extent, lose, and which in the nature of things they cannot regain. In large cities having a considerable suburban traffic the trolley roads, forming as they do a network of lines within the city and extending in every direction into the suburbs, offer advantages with which the steam roads cannot compete. In Philadelphia one of the large steam lines lost so much traffic that it has attempted to regain it by reducing prices and increasing the number of trains. In this effort it has partly succeeded, but at the cost of greater expense and decreased receipts. To counterbalance this loss at central points railroads may hope, by the introduction of electricity, to increase their earnings along the lines and on their branches.

As to the nature of the equipment that will be required, it would depend on the work to be done and the branch that is to be equipped. In some cases it might be well to use single electric cars running on the steam tracks between towns and on the local tram lines in the towns. As the speed would be very different in the town and on the railroad line, and as the voltage could also be different, it would be well in this case to use a number of motors on the car, and to use a series parallel controller, the motors being in series for the town traffic. For instance, suppose we wish to run at a maximum speed of 40 miles per hour between two towns, and it is economical to use 1,000 volts on the line, we could use two motors on the car, run them in parallel on the main line at a speed of 40 miles per hour, while in town, with a voltage of 500, we could run them in series at a speed of 10 miles per hour. I can hardly imagine a case where the three-wire system could be economically used for such service on the steam lines.

The condition of affairs in electric transportation is at present, curious. The trolley companies, by extending their lines, are working from tramway transportation to through transportation. They are attacking the problem by development from small motors to larger ones. The railroad companies starting with the large units are coming down in the direction of the present trolley systems, as in the case of the Nantasket Beach Road of the New York, New Haven & Hartford Company. Perhaps in the future they will meet and some standard electrical system will be adopted for the present steam road. I think then, that in the case taken up, the policy of the road will be to equip those branches for which the conditions are favorable with a trolley, run comparatively large motor cars capable of drawing one or two ordinary passenger or freight cars as trailers, using the present steam service for their freight traffic when necessary. This will allow the necessary through travel, will give the required local service between towns and will not interfere with the freight traffic.

As for the systems to be used for such services, I believe that at the present moment the continuous current overhead trolley system is the only one that can be selected with a certainty of successful operation. It gives a minimum complication in the way of conveying the current to the cars, it allows a considerable range of speed with a comparatively high efficiency, and our experience with it is such that successful operation could be at once guaranteed. By using different voltages in the towns and on the line both high and low speeds can be obtained. If the line to be operated is to be very long, it might be best to use rotary transformers at different sub-stations along it, the line being supplied by continuous currents from the sub-stations. In fact, the three systems that are at present possibe are: First, the ordinary direct current system; second, a system in which direct currents are used on the line and rotary transformers supplied by alternating currents are placed along it, and third, a two or three-phase system supplying rotary field motors on the cars. In the latter case it would be well to employ different periods in the towns and on the lines.

The second case which I wish to consider is that of roads built for an entirely new electrical equipment such, for instance, as the elevated roads in Chicago and the underground rapid transit road in New York, or the proposed Washington-Baltimore Boulevard line. In most of these cases the traffic is almost entirely a passenger traffic, and the conditions are especially favorable for the operation of electricity. Taking, first, the case of the New York underground road, there will probably be required about 150 trains for local service, each train having five ordinary cars and a motor car. For the express service there would be about 25 trains of, say, four ordinary cars with a motor car. For this it would probably be best to use the direct-current three-wire system, one of the cars on the train being equipped with motors and acting as a locomotive. With four motors on a car the system would be efficient at all practical speeds, and if desired a large part of the energy could be thrown back on the line when the cars are being stopped. In the case of the local trains, a simple calculation will show that a very small part of the total energy expended is used in overcoming the track resistance, while a very considerable part is employed in accelerating the train and afterward wasted by braking. I have calculated the amount of energy which can be practically saved under the conditions of local and express traffic on the New York underground road, and find that with motors of ordinary efficiency about 45% can be returned. If storage batteries are used in connection with the central stations, the batteries being located along the line, a uniform load can be thrown on the stations, and their capacity may be reduced to almost one-half as compared with a system in which the energy is not returned, thus greatly decreasing both the expense of installation and of operation. As it is possible at present to obtain batteries with a rapid discharge rate at very reasonable prices and with a guarantee for repairs that place them well within the limit of commercial calculations, a system of this kind offers some advantages over any other system that could be applied to the operation of the under ground road. An alternating current would hardly be economical for this work, as it precludes the possibility of returning the energy to the line, and as the variable speed required makes it uneconomical as compared with the direct-current system using, say, four motors with series parallel control. In the case above cited, shunt motors would be used, and it would be possible to get a contact with the line that could not under any circumstances be broken. The case of the elevated roads is very similar to the one I have cited, except that in existing structures shorter trains would be used, and the cost of equipment for a given number of cars would be somewhat greater.

Baltimore has been the pioneer in almost every branch of transportation. In ocean service, the record of the Baltimore Clipper is a tradition of our maritime supremacy. The Baltimore & Ohio railroad was the pioneer steam road. An electric road from Baltimore to Hampden, built in 1885, gives us a right to boast of our pioneer work in electrical tramways The immense locomotive for the Baltimore Belt Line Tunnel is the first instance of the direct displacement of steam by electricity, and the line over which it is to be operated is the first through steam line to be equipped electrically. The Baltimore & Columbia Railway Company owns in Washington the Eckington and Soldiers' Home Railroad and the Belt Line railroads and has franchises for extensive additions to their present mileage. In Baltimore they are constructing a road in the city and beyond it to Ellicott City, and they have also purchased a steam line running from Baltimore to Catonsville. They have rights of way from the terminus of their Baltimore lines to the lines they own and are preparing to build in the District of Columbia. The problem offered is not a simple one, but it is one of the most attractive that can be presented to electrical engineers. Speeds of 60 miles per hour are to be used for the cars outside of the city limits, and within the city limits ordinary speed is to be employed. In the District of Columbia overhead trolley lines are not allowed and some type of conduit will have to be employed. In fact, there is presented almost every problem which must be solved if electricity is to displace steam in the future with the same rapidity that it has done in the past. Many high-speed electric roads have been projected, a number of them occupying considerable space in the newspapers, but I think this road will be the first to solve the detailed problem of interurban rapid transit.

The last subject which I wish to take up is the electric plant for the Belt Line Tunnel of the B. & O. Railroad. In this case there is no question of economy in the employment of the electrical locomotives, as the plant adds considerably to the cost of operating the road. The Belt Line Tunnel runs beneath the city of Baltimore for a distance of one and one-quarter miles, then to the outskirts of town through open cuts and short tunnels. There is a grade of .8 of one per cent over almost the entire length of the tunnel proper, while one-half mile beyond it there is a grade of one and one-half per cent. Being in the middle of town it would have been difficult to have provided a satisfactory ventilating plant, even supposing that ventilating plants had been successful in other localities, which is not the case. The managers of the B. & O. Rail road Company wished to provide a satisfactory service, and considered a number of plans for drawing their trains through the tunnel without the annoyance due to smoke and gases. After careful consideration, they concluded that electricity was the most satisfactory means to accomplish this, and the General Electric Company was confident enough of its ability to successfully equip the road to make a contract with the B. & O. company to haul its trains over the Belt Line, the contract being dependent upon the successful operation of the plant. The total length of the line equipped is about three miles, the extension beyond the tunnel being for the purpose of assisting the freight locomotives to haul their trains up the one and one-half per cent grade on the line beyond the tunnel. There are to be three locomotives and it is calculated that the traffic can ordinarily be handled by two of them. The steam engines are not to be taken off the train, but hauled through the tunnel by the electric locomotive which switches off at the terminus of the line. To operate these machines a station has been erected which contains 3,000 horsepower of electric generators, and an overhead line has been equipped to transmit the current to the locomotives. With respect to the station itself, there is little that is novel. There are four 750 horsepower Allis-Corliss engines directly coupled to generators of the same capacity, the generators having a voltage of 600 at no load and 700 at full load. The foundations have been partly erected for a fifth unit in case it is found necessary. The building also contains a lighting plant having a capacity for 400 arc lights and four thousand 16-candle-power incandescent lights. Provision has also been made for an extension to this lighting plant when the stations for the Belt Line are erected. There are two incandescent machines and one of them will be used to supply the one thousand 32-candle power lamps which have been installed in the tunnel. Perhaps the most novel feature of the plant is the overhead structure that is employed. The conditions to be met were peculiarly difficult, and the ordinary under running trolley was considered impracticable. The tunnel is very low in places and the management of the road decided that the conductors could not be placed over the cars, but should be placed in the middle of the tunnel between the tracks. Outside of the tunnel the conductor is still between the tracks, but is elevated to a height of 22 feet, while inside of the tunnel it is only 17 feet from the top of the rail. The conductor consists of an iron trough made of two Z bars riveted to a cover plate 12 inches wide, leaving a slot one inch wide between the Z bars. In the tunnel this trough is supported from transverse channel bars secured to expansion bolts which are fastened in the top of the tunnel. There is a double insulation, one porcelain insulator being between the trough and the channel bars, and another between the channel bars and the expansion bolts. Outside the tunnel the trough is supported as follows: At distances of 150 feet light iron columns with cross trusses are erected, and between these trusses are hung catenaries supplied with a number of suspension bolts. Transverse channels similar to those used in the tunnel are fastened to these bolts, and the trough is fastened to the channels. The Z bars are made in lengths of 30 feet, the opposite bars breaking the joints with one another, the lengths being riveted together and then bonded with "Chicago" rail bonds. Suspended on the same transverse beams as the trough are three copper cables of 1,000,000 centimetres area which serve as feed wires, and which are connected at intervals with the trough, there being, of course, one trough for each track. For the return circuit the tracks are bonded as in ordinary railroad work, there being cross bonds and at intervals connections with a copper cable of 1,000,000 centimetres area carried in a wooden trough between the tracks. The contact arrangment that is to be used consists of a brass shoe traveling in the trough and connected with the locomotive by a flexible saw buck arrangement which has a very considerable range in every direction. The current is transmitted to the motors by a copper cable, and in case of the shoe sticking in the trough, a safety pin is arranged to break with any desired strain. Where switches are used there is a tongue worked by the lever which operates the track switch, and which serves to direct the shoe. This structure, although exceedingly massive and expensive, promises to give an excellent contact at all times, and it requires no care from the motorman.

The locomotives are the most massive in the history of either steam or electrical transportation, and the weight, which amounts to 95 tons, is on eight driving wheels so that the full tractive power of the locomotive will be developed. On each axle there is sleeved a 6-pole motor, there being considerable play between the axle and the sleeve, which latter is spring supported from the frame. In this way any heavy blow due to irregularities in the track is taken through the springs and the wear both of the track and locomotive is reduced. On the armature shaft are projecting arms which move between lugs cast on the wheels, thus allowing the necessary relative motion between the axle and armature.

The situation in the Baltimore Belt Line plant is this: The station is completed, and is being operated daily. One of the locomotives is on the ground set up and ready to run, and the overhead work is finished with the exception of a short length which was interfered with by a temporary bridge over a cut. The latter has been removed, and the plant should be ready to run this week.

If this equipment proves successful, it will open a limited but important field for the introduction of large electric locomotives. There are in the United States a number of tunnels whose operation is anything but satisfactory at present which can be equipped as the Baltimore Tunnel is. Not only would the economy of the station be increased, but the substitution of electric for steam switching engines would result in a very considerable saving.

This is the last of the subjects that I proposed to consider. In this paper I have not indulged in prophecy, nor have I imagined any apparatus or equipment which cannot be bought to-day in the open market. But to me it seems that the present is a crisis in the history of railroading. Up to the present the steam roads have ignored the competition of electric roads, or they have fought them. To-day they cannot afford to do either. In a few years electric roads will have absorbed practically all of the local traffic, and will begin to cut into through transportation. The steam roads cannot afford this, and their only safety is to make of electricity an ally instead of an enemy, and this before it is too late.

The conclusions that I finally reach are:

1. The tendency of passenger transportation on the steam lines has been in the direction of the greatest electrical economy, while the tendency of the freight transportation has been in the direction of the least electrical economy.

2. It will not pay any through line with considerable traffic, having two tracks, to equip their main tracks electrically.

3. With four-track roads it will pay to equip all of the tracks electrically unless a considerable portion of the business is through passenger traffic.

4. It will pay all the larger roads either to equip a number of their branch lines electrically, or to control competing electric lines.

5. In order to remain on a dividend paying basis it is imperative that most of the two-track lines either build additional tracks or control the electric railroads that parallel them.

6. Believing that ultimately all of the traffic will be done by electricity, it is imperative that the managers of steam roads keep in touch with electrical progress.

TESTS OF A COMBINED ELECTRIC LIGHT AND ELECTRIC RAILWAY CENTRAL STATION.

READ BEFORE THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, DETROIT, JUNE, 1895, BY DUGALD C. JACKSON AND ARTHUR W. RICHTER.

The central station of the Four Lakes Light and Power Company supplies the power for the electric lighting of Madison, Wis., and also supplies power for the Madison City Railway. The station is situated on the bank of Lake Monona, in a fairly central location (Fig. 1).

The boiler room contains two return tubular boilers, rated at 110 horse-power each, and one Stirling boiler of 200 horse-power capacity. The engine room is equipped with three Russell compound engines, two Davidson jet condensers, and two Davidson feed-pumps.

Engine No. 1, 380 horse-power capacity, is belted to the main shaft, from which are run four Thomson-Houston arc light machines, each of which has a capacity of fifty 1,200 candle-power lamps, and one Westinghouse alternator of 750 lights capacity. Two other alternators, a Slattery and a Thomson-Houston, are also installed but are to be removed.

Engine No. 2, 190 horse-power capacity, is used for running the railway generators. These are two 90-kilowatt General Electric machines of 500 volts, 180 amperes, speed 650, and are belted tandem fashion from the fly-wheel of the engine. A third tandem belt from the same fly-wheel runs over a clutch pulley on the main shaft, and the shaft can therefore be driven from this engine when desired. The two generators are connected to the same bus-bars, and supply power for the operation of the Madison Street Railway, and for a number of stationary motors which are connected to a special power circuit run out from the bus-bars. Both of the above engines are connected to one of the Davidson condensers.

Engine No. 3, 400 horse-power capacity, is directly connected to a 300-kilowatt "monocylic" alternator, and condenses into another Davidson condenser and air pump. The alternating current output of the station is used exclusively for incandescent lighting.

ENGINE DIMENSIONS.

Nos. 1 and 3. Stroke, 24 inches; diameter of high-pressure cylinder, 15 inches; diameter of low-pressure cylinder, 24 inches; diameter of high-pressure piston rod, crank end, three inches; diameter of high-pressure piston-rod, head end, two and three-eighths inches; speed, engine No. 1, 134 revolutions per minute; speed, engine No. 3, 153 revolutions per minute.

No. 2 railway engine. Stroke, 20 inches; diameter of high-pressure cylinder, 13 inches; diameter of low-pressure cylinder, 20 inches; diameter of high-pressure piston rod, crank end, two and three-quarters inches; diameter of high-pressure piston rod, head end, two and one-quarter inches; speed, 133 revolutions per minute.

The station is operated by one engineer and one fireman from midnight until noon, and by one fireman, one head engineer and one assistant from noon until midnight, and one oiler from 6 P. M. until 12 P. M., making a total of six station employés for the 24-hour run. Each 24 hours during the week current is furnished to the electric railway and power circuits for 17.5 hours, and to the alternating current circuits for 23.5 hours, except on Sunday, when the alternators are shut down for an additional 12 hours. Current for arc lighting is supplied principally between the hours of dusk and midnight, though certain arc light circuits are operated all night.

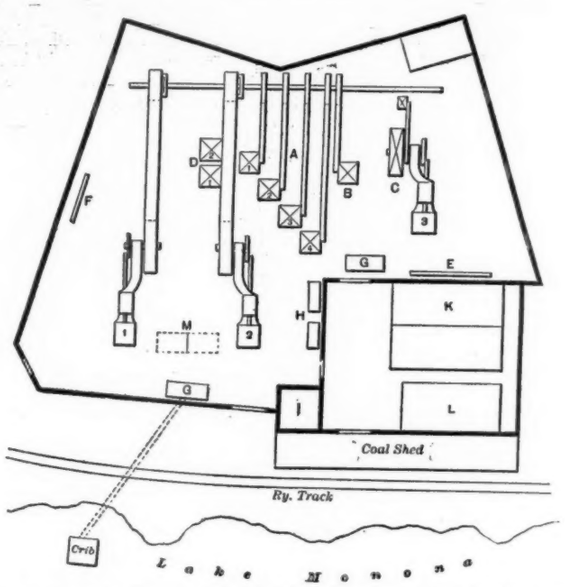

FIG. 1.—A, arc light dynamos; B, Westinghouse alternator; C, monocyclic alternator; D, railway generators; E, electric light switchboard; F, electric railway switchboard; GG, condensers and pumps; H, feed pumps; I, oil room; K, return tubular boilers; L, Stirling boiler; M, hot wells; 1, 2, 3, Russell engines.

This station is one of that type, so well known to electrical engineers, which has grown to considerable proportions from a small and poorly conceived beginning, and which therefore may be said to suffer through its own growth. During the past two or three years it has been quite thoroughly overhauled, and its physical condition has been greatly improved, but only at the expense of a considerable addition to the capital account. The results of the test which are given may be taken to represent results fully equal to those obtained by the average electric station in our cities of the smaller size. (Madison has 15,000 inhabitants.) This statement will, doubtless, be viewed with surprise by the numerous members of this society who are experts in steam engineering and who carry continually before their eyes the remarkable economy obtained in pumping plants, but that the statement is fully borne out by the facts will be affirmed by every electrical engineer of experience.

The object of the test recorded in this paper was to determine the efficiencies of the boilers, engines and generators under actual operating conditions, nothing having been done either before or during the test to change the conditions from those occurring in the regular daily run. All the data required were obtained and recorded entirely independently of the regular employés, who were required to attend to the operation of the station, exactly as is done day after day and week after week. A trial test of four hours' duration was made beforehand in order to familiarize the observers with their work and to ascertain whether all the arrangements were well conceived. All reasonable precautions were used to make the data obtained reliable, and all instruments were supplied from the laboratories of the University of Wisconsin and were compared with the laboratory standards. All electrical instruments used were calibrated by means of a Kelvin standard balance. The steam pressure gauges and indicator springs were standardized by comparison, while hot, with a mercury column. The scales, thermometers, etc., were tested for accuracy by comparison with proper standards.

The test began at 6 A. M. Monday, when the engines started up for the day, lasting until 5.30 A. M. Tuesday, when the engines stopped for their half-hour breathing spell, and may be considered successful, as nothing more serious than the occasional breaking of an indicator cord occurred to interfere with the results. Four of the observers, one having general supervision of the test, another overseeing the weighing of the coal, another the weighing of the water, and a fourth having charge of the calorimeter tests, were on duty through the entire run. These four men, Messrs. Burgess, Frankenfield, Mead and Crane, were members of the senior class in electrical engineering in the University of Wisconsin and handled their work excellently. They were assisted by a certain number of experienced student observers, about 20 in all, who were required to read the various ampere meters and voltmeters, take indicator cards, etc. The test was generally supervised by two of the assistant professors of the university. During the whole of the test the station presented no confusion, but was operated with the usual systematic regularity.

TESTS.

The coal was weighed as it was brought into the boiler room. The water level and steam gauges were kept as nearly constant as practicable, and at the close of the test the water in the Stirling boiler was at the original level, while in one of the return tubular boilers it was 1.5 inch above the string and in the other a little over an inch below it, so they were considered as practically at the same level. The Stirling boiler was in use during the entire run, and at 4.45 P. M. and at 5.45 P. M. the two tubular boilers were successively cut in and were shut off again and the fires banked at 12.35 A. M. The coal used in getting these boilers up to pressure (nearly 500 pounds) was not counted as part of the coal consumption in the computed results.

Calorimeter tests of the steam were made every hour at the boilers, and as frequently as possible at the engines, while in service. Throttling calorimeters were used, except at the railway engine, during the daytime, where there was so much water present that the throttling calorimeter could not be used, and a separating calorimeter was resorted to. The poor quality of the steam at the engines was due to the arrangement and condition of the steam mains. Engine No. 2 received the drain of the greater portion of the system. The steam-pipe was connected to the under side of the main and was uncovered at the time of the test. The pipe leading to engine No. 3 was also uncovered, and as the pipe is of considerable length the condensation is considerable, while the valve provided to cut the steam from that pipe during the period when the engine is idle was

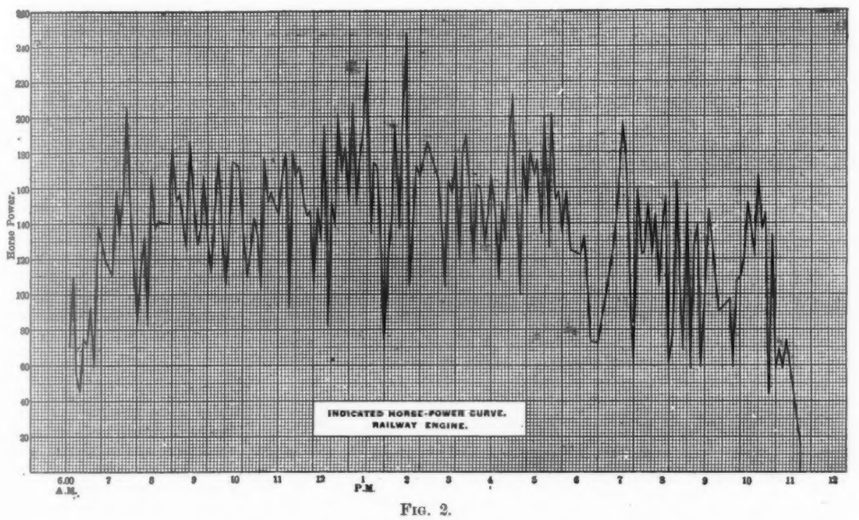

FIG. 2.

not made use of. The pipe leading to engine No. 1 was covered, but no provision was made to cut the steam from that pipe when the engine was nor running.

The water was measured by means of two tanks placed on scales. Both feed-pumps were put into use, one as an auxiliary to pump the water from the hot well into the tanks, and the other to feed the boilers. The latter pump communicated with the tanks by two branches of piping connected by a three-way cock, and a hose was attached to the other pump, so that one of the tanks was filled while the other was being emptied. The exhaust pipe of the regular feed-pump was connected to the vacuum of the condenser, and the steam consumption was figured from cards taken at frequent intervals, the number of strokes being recorded on a continuous recorder. The steam consumption of the auxiliary pump was ascertained by running the exhaust into a small surface condenser furnished from the university laboratory, by which means the condensed water was collected and allowance made therefor.

The railway engine, No. 2, was started at 6 A. M. and continued running until 11.10 P. M. During the day, from 6 A. M. until 6.30 P. M., this engine, besides driving the two railway generators, drove the main shaft, to which a Westinghouse alternator was belted, supplying the day demand on the incandescent circuit. This engine was indicated every five minutes, indicators made by Dreyer, Rosenkranz and Droop, of Hanover, Germany, being used on the low-pressure cylinder, and Tabor indicators on the high-pressure cylinder. These indicators were supplied with electro-magnetic devices for taking the four cards simultaneously on closing a switch, the current being supplied from storage cells. Friction cards were taken upon starting up with the generator fields excited and again with the field circuit broken. The speed was obtained by means of a continuous revolution counter. Two ampere meters, through which the current supplying the railway feeders passed, one ampere meter on the power circuit, and a voltmeter giving the dynamo pressures, were read every half-minute. The condenser pumps were indicated at half-hour intervals and the speeds were taken.

At 6.10 P. M. the arc light engine, No. 1, was started and continued running until 5.30 A. M. At the same time the direct-connected engine, No. 3, was set running, and the supply for the incandescent circuit was changed from the Westinghouse machine to the "monocyclic" alternator. The railway engine, No. 2, now no longer drove the main shaft, but the belt ran over a loose pulley on the shaft. The arc light engine, No. 1, was indicated every 15 minutes, and the direct-connected, No. 3, every 10 minutes, and the speed obtained from continuous revolution counters. Friction cards were taken both before and after the run. The current of the arc machines was measured by a Weston ampere meter, and the voltage was obtained by a Weston voltmeter in series with a high resistance, the apparatus being placed as far from the machines as possible to avoid any disturbance which might be caused by stray magnetism. Ampere meter and voltmeter readings for the Westinghouse alternator were taken every 15 minutes, and the "monocyclic" output was taken by five-minute readings. The power factor of the load on each of the machines was ascertained by means of a station wattmeter, loaned by the General Electric Company.

There can be no question in regard to the reliability of the results averaged from readings taken as often as was done in this test, except in the case of the railway machinery. It is still an open question as to the best method of determining the average power developed by an electric railway engine; but the results of considerable experience with electric railways on the part of one of the authors make us feel certain that results are obtainable by the arrangements which were used in this test, which are as accurate as those obtainable by any method yet set forth.

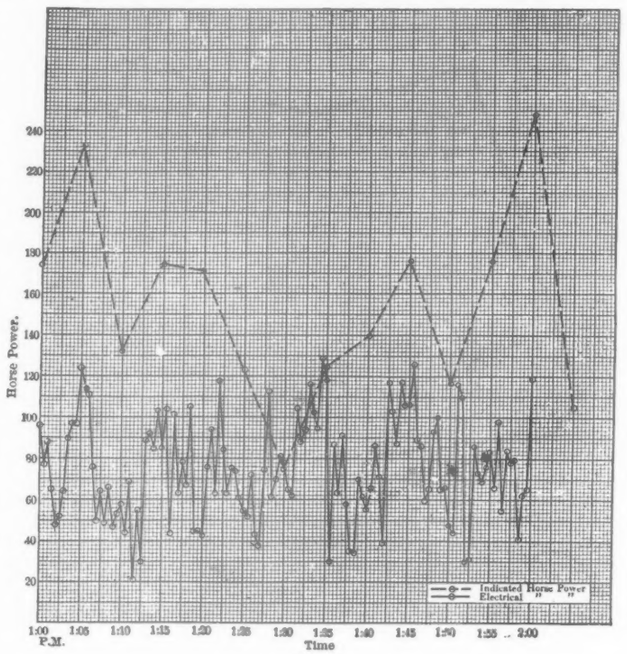

FIG. 2A.

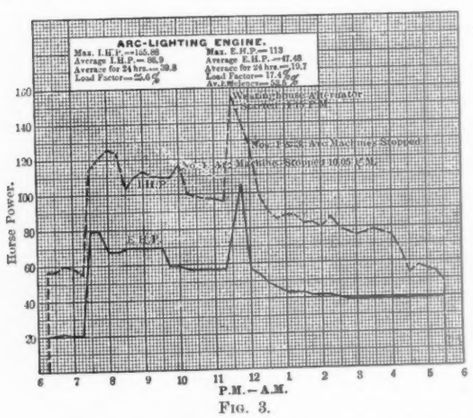

FIG. 3.

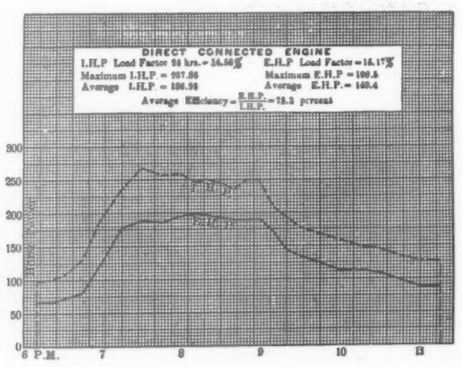

FIG. 4.

RESULTS OF TEST.

Boiler efficiency.

Quality of steam:
- Stirling, 6 A. M. to 6 P. M., 99.2 per cent.
- 6 P. M. to 5.30 A. M., 99.7 per cent.
- Return tubular boiler No. 1, 4.45 P. M. to 12.30 A. M., 97.3 per cent.
- Return tubular boiler No. 2, 5.45 P. M. to 12.30 A. M., 98.5 per cent.
- Total average, 98.8 per cent.

Average pressures:
- Steam, 89.5.
- Barometer, 29 inches.
- Draught (inches of water), .3.

Average temperatures:
- External air, 46.2 degrees Fahr.
- Boiler room, 58.9 degrees Fahr.
- Escaping gases, 422 degrees Fahr.
- Temperature of hot well, 82.24 degrees Fahr.
- Temperature of feed water, 123.5 degrees Fahr.

Factor of evaporation, 1.119.
Water pumped into boilers, 102,349 pounds.
Equivalent evaporation from and at 212 degrees, 114,508 pounds.
Total amount of coal burned, 17,103 pounds.
Total ash, 1,871 pounds.
Total combustible, 15,232 pounds.
Per cent ash, 10.9 per cent.
Water evaporated per pound of coal, 5.98 pounds.
Water evaporated per pound of combustible, 6.72 pounds.
Equivalent evaporation from and at 212 degrees, per pound of coal, 6.69 pounds.
Equivalent evaporation from and at 212 degrees, per pound of combustible, 7.52 pounds.
Steam used in throttling calorimeters, 385.7 pounds.
Steam used in separating calorimeters, 35.07 pounds.
Total, 420.8 pounds.
Steam used by feed pumps, as figured from indicator cards, from 6 A. M. to 6 P. M., 538.5 pounds. From 6 A. M. to 5.30 P. M., 472.3 pounds.
Total, 1,010.8 pounds.
Steam used by auxiliary pump, 449 pounds.
Steam to be charged to engines, 100,469 pounds.
Engine efficiency, No. 2 railway engine, 6 A. M. to 6 P. M:
- Average I. H. P., 117.5.
- H. P. hours, 1,410.
- Average watts output, 69,200, equals 92.8 E. H. P.
- Watt hours, 830,387.
- Average E. H. P. divided by average I. H. P. equals 78.9 per cent.
- Coal consumed in 12 hours, 7,550 pounds.
- Per cent ash, 9.9 per cent, equals 750 pounds.
- Combustible, 6,800 pounds.
- Water pumped into boilers, 43,172 pounds.
- Steam consumed by pumps and calorimeters, 891 pounds.
- Water charged to engine, 42,281 pounds.
- Water per I. H. P. per hour, 30.0 pounds.
- Coal per I. H. P. per hour, 5.35 pounds.
- Combustible per I. H. P. per hour, 4.82 pounds.
- Quality of steam, 95.7 per cent.
- Moisture in steam, 4.3 per cent.
- Dry steam used by engine, 40,460 pounds.
- Dry steam per I. H. P. per hour, 28.7 pounds.
- Watt hours, per pound of coal, 109.9.
- Watt hours, per pound of combustible, 122.1.

Station efficiency:
- 6 A. M. to 5.30 A. M., 23.5 hours.
- Average I. H. P. for 23.5 hours, 160.5.
- Maximum E. H. P., 350.4.
- Average E. H. P. 117.9.
- Average watts for 23.5 hours, 87,946, which is 2,066,729 watt hours.
- Average E. H. P. divided by I. H. P., 73.4 per cent.
- Load factor for 24 hours, 32.4 per cent.
- Coal consumed, 17,103 pounds.
- Combustible, 15,232 pounds.
- Water pumped into boilers, 102,349 pounds.
- Steam evaporated and charged to engines after subtracting that used by calorimeters and feed pumps, 100,470 pounds.
- Water pumped into boilers per engine I. H. P. hour, 27.1 pounds.
- Coal per engine I. H. P. hour, 4.5 pounds.
- Combustible per engine I. H. P. hour, 4.0 pounds.
- Watt hours per pound of coal, 121.
- Watt hours per pound of water, 30.8.
- Average quality of steam, railway engine, 96.2 per cent.
- Average quality of steam, arc light engine, 97.1 per cent.
- Average quality of steam, monocyclic engine, 97.8 per cent.
- Average, 96.8 per cent.
- Dry steam used by engines, 97,214 pounds.
- Dry steam per engine I. H. P. hour, 25.8 pounds.
- Average I. H. P. of condenser pump No. 1, 2.62.
- Average I. H. P. of condenser pump No. 2, 1.96.
- Horse-power hours of condenser pump No. 1, 61.6.
- Horse-power hours, pump No. 2, 9.8.
- Friction load of engine No. 1, 22.4 with shaft.
- Friction load of engine No. 2, 12.2 without shaft.
- Friction load of engine No. 3, 22.5.

Total friction load, 57.1 I. H. P. = 11.8 per cent of maximum I. H. P.

CONCLUSIONS.

The principal results of the tests are shown graphically in the accompanying figures. Fig. 1 shows the general arrangement of the plant; Fig. 2 the indicated horse-power of the railway engine during the day; Fig. 2*a* the indicated and electrical horse-powers of the railway plant during one hour; Fig. 3 shows the indicated horse-power of the arc light engine and the electrical output of the dynamos driven from it; Fig. 4 shows the same thing for the direct-connected engine. In Fig. 5 the full line shows the total indicated horse-power developed in the station during the test, while the differently shaded areas show the part played by each of the three engines. Fig. 6 shows the variation of the steam gauge reading during the test; the corresponding corrected pressures are seven pounds lower. During the period of lightest load the steam pressure is ordinarily carried about 45 pounds lower than the full load pressure, in order to keep the engines at a fairly economical cut-off.

During the past three years several papers have been read before this society dealing with the operation of electric railway stations, but no authoritative records appear which cover the operation of the average small station, which combines in one the requisite plant for electric light-

ing and electric railway service. The individual action of engines, dynamos and auxiliary apparatus, under the conditions here met with, is so well known that it is thought best by the authors not to burden this paper by indicator cards of well-known forms, or by long tabular records. We wish, rather, to call attention to certain points which bear with somewhat startling force upon the expense of operating these combined stations. It has usually been considered that combination stations may be operated at much less total expense than is required for the operation of two small stations when the lighting and railway plants are separate. This question may be considered under four heads. First, station labor; second, fuel economy; third, superintendence; fourth, fixed charges.

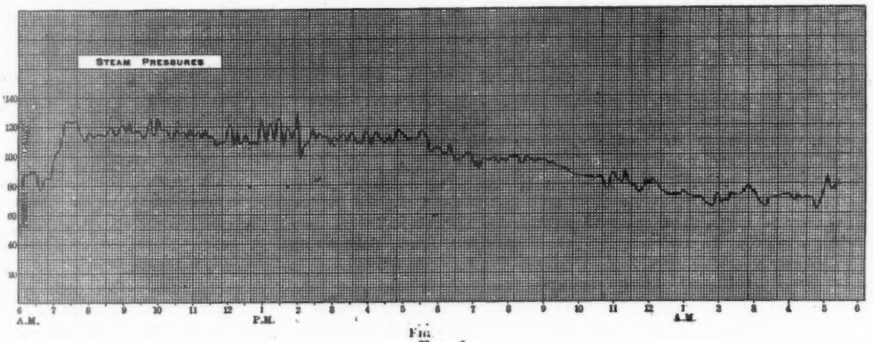

FIG. 6.

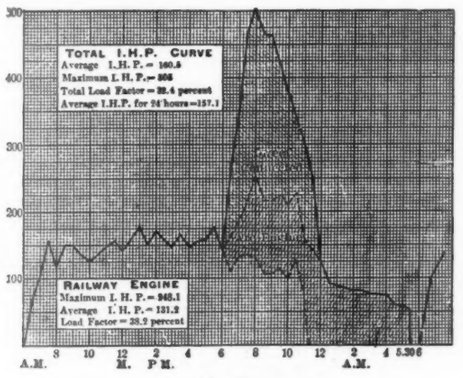

FIG. 5.

1. In regard to station labor, the plant under consideration (which we will call the Four Lakes plant) probably could not be improved, and if the lighting and railway divisions were separated, not less than seven men would be required where five men are now employed, and the labor account would be proportionally larger for two stations than for one.

2. The fuel economy of the Four Lakes plant is fully equal to that of the average medium-sized plant, but it is probably no better than would be given by similar engines and other machinery in separate plants. The coal used during the test was a mixture of Indiana block, costing $3.35 per ton. and Illinois coal, costing $2.72 per ton. The evaporation shown by the boilers was, on the whole, excellent, considering the kind of coal used and the fact that the boilers were in regular service condition. The fuel economy of the Four Lakes plant could be improved by several minor changes; this is especially true in regard to the arrangement of the dynamos, which now require the countershaft to be unnecessarily run all day, and in regard to the piping, which might be readily changed to deliver better steam. (Some of these changes have already been made since the test.) But these changes would not give the combined plant any advantage over the separate plants. Better fuel economy would also be obtained by closer attention to the details of operation than is given in this plant, but the watt hours developed per pound of coal and per pound of water compare favorably with the reports of the National Electric Light Association for similar stations.

3. The question of superintendence requires consideration from two sides; first, where the railway and light companies are independent and the latter sells power to the former; and, second, where one company controls both industries. In the first case no saving is made in office force or superintendence by combining the stations; but, in the second case, a saving is doubtless effected by the combined plant.

4. The preceding divisions give little clew to the best solution for the electric plants of the smaller cities, and we must find the solution in this division. The fixed charges which may be rightfully considered as belonging to the station account depend upon the cost of real estate, buildings and the machinery in place. The first two items are undoubtedly increased to some degree in the separate plants, but not so largely as might be imagined, since the running machinery for the two classes of service must be entirely independent. It is practically impossible for any engine to drive the extremely variable load of an electric railway and regulate with sufficient accuracy to give satisfaction when driving dynamos for electric lighting; and, since the underwriters have taken the matter in their hands, it is not permissible in most places to operate stationary motors from railway circuits, on account of the fire risk involved in introducing grounded circuits into buildings. On account of this separation of the two classes of machinery the real estate and buildings required for combined railway and lighting plants must be larger than would be necessary for either a simple lighting plant or a simple railway plant of a capacity equal to the combined plant.

The comparison of the load factors of separate and combined plants throws no particular light on this question. Thus, in the Four Lakes station, the 24-hour engine load factor for the railway machinery, plus the day alternator, is 38.2 per cent. For the arc light machinery alone it is 25.6 per cent; for the direct-connected alternating machine it is 14.56 per cent. The total load factor of the station is 32.4 per cent. The term "engine load factor" is used here in its usual signification of the ratio between the actual indicated horse-power hours' output of the station and the output which would be produced were the station run continuously at its maximum indicated load. Now, upon separating the lighting and railway outputs, we still have the railway load factor about 38.2 per cent and the lighting load factor becomes about 23 per cent.

Practically the same amount of boiler power is required in the combined stations as in the separate stations, and exactly the same plant in engines and dynamos are required in the two cases. The boilers, engines and dynamos are each run at about equal average loads in the two cases, and the efficiencies are not materially different.

We therefore make the following gains by combining the electric lighting and railway plants of small cities into one station. First, a fair amount in the labor account; second, a small amount in the real estate and building account. The gains are not nearly so great as are sometimes asserted, nor are they comparable in magnitude to those which result from the combination of two small electric light stations in one, or two small electric railway stations in one, since, in the latter cases, one economical plant of machinery may be used to do the work of two smaller and less economical plants. When a railway and a lighting station are combined, we are forced by the conditions to use separate machinery (excepting boilers) for the two classes of service.

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ADVANCE INFORMATION.

VALUABLE INFORMATION FOR MANUFACTURERS AND DEALERS.

We publish below the earliest information obtainable relating to new electric railways, new electric light companies, new telephone companies and projected electric construction of all kinds. Every reader will find these columns of special interest, and manufacturers and supply houses will receive many valuable suggestions looking to new business by carefully watching this department in the ELECTRICAL REVIEW from week to week.

Increase of Capital Stock.

PHILADELPHIA, PA.—The Electric Traction Company have decided to increase the capital of the company from $7,620,000 to $8,750,000.

BROOKLYN, N. Y.—The stockholders of the Edison Electric Illuminating Company voted to increase the capital $750,000 to $3,750,000, and authorized the issue of $500,000 additional bonds with which to purchase control of the Citizens' Electric Illuminating Company and make further extensions.

CHICAGO, ILL.—Standard Electric Company has increased its capital stock to $1,500,000.

Business Troubles.

ALLENTOWN, PA.—The Inter-County Electric Railway Company's trackage and partly finished plant was sold at sheriff's sale. The sale took place at Tamaqua. The liabilities of the company amount to over $20,000.

MIDDLETOWN, CONN. — Ex-Congressman Lewis Sperry has been appointed receiver for the Schuyler Electric Manufacturing Company, of this city. The company sold its assets to the Schuyler Electric Company and the Supreme Court has decided that the sale was illegal. All the assets must be returned to the former company, and there are a number of complications that must be straightened out. Attorney Clarence E. Bacon, of this city, has been appointed master to determine the amount due the old company from the Schuyler Electric Company. Bonds for the receiver were fixed at $25,000 and Mr. Sperry qualified.

New Manufacturing Companies.

TOLEDO, OHIO.—The Bissell, Dodge & Erner Company has been incorporated by Frederick Bissell, Frederick H. Dodge, John A. Erner, A. W. Scott and G. G. Kelp to manufacture electrical and other machinery. Capital stock, $25,000.

NORWALK, OHIO.—The Northern Electric Company has been incorporated by George P. Jones, Parks Foster, Mayme C. Foster, Burton P. Foster, John W. Foster. Capital stock, $25,000.

BATESVILLE, IND.—The Batesville & Oldenberg Electric Company has been incorporated by K. M. Hord, Bellami Sutton, E. K. Adams and John A. Tindall, of Shelbyville; Jonas Joseph, of Noblesville; John Hillenbrandt, of Batesville, and others, with a capital stock of $50,000.

DETROIT, MICH.—The Wolverine Electric Company have filed articles of association. The capital stock is $10,000. Charles F. Scott, Ida A. Marks, Henry A. Marks, Hiram Marks and George A. Brooks, Piqua, Ohio, are the incorporators.

EAST ST. LOUIS, ILL. — The Amplified Electric Company has been incorporated. Capital stock, $1,000,000. Incorporators, Frederick Ulrich, Edwin J. Paule and John T. Dodwell.

NEW YORK, N. Y.—The C. J. Field Company has been incorporated by Cornelius J. Field, of Brooklyn; Frank Bourne, of Mount Vernon, and John W. Gilmore, of New York city, to conduct an electrical and mechanical consulting and engineering business. Capital stock, $4,000.

KITTERY, ME.—The Chaplin Company has been organized for the purpose of purchasing, manufacturing and selling electrical, mechanical and chemical inventions, with $75,000 capital stock. The officers are: President, E. D. Chaplin, of Cambridge, Mass.; treasurer, H. L. White, of Somerville, Mass.

CAMDEN, N. J.—The American Construction and Improvement Company has been incorporated, with a capital stock of $100,000, to construct and repair railroads, gas and electric works, etc.

DES MOINES, IA.—The Hall Electric Power and Reduction Company, of this city, has been incorporated. Capital stock, $500,000. Incorporators, Robert H. Laird, Truman Mills Hall, Thurman Gordon Hall.

Electric Light and Power.

WILMAR, MINN.—J. L. W. Zietlow, electrician, is preparing plans for a new electric light plant that is to be erected in this city.

HASTINGS, NEB.—The People's Light, Heat and Power Company has been incorporated by William E. Brevoort, Chas. E. Bascombe and Samuel S. Campbell, with a capital stock of $100,000.

MADISONVILLE, OHIO.—The Waterworks Trustees have requested the issuance of $5,000 worth of bonds, for the purpose of extending the electric light system.

ADAMS, VT.—Adams Power Company has been incorporated with Charles A. Howland, president; W. H. Wellington, treasurer; for the purpose of conducting a power station, etc. Capital stock, $250,000.

DUNLAP, IOWA.—Steps are being taken to establish an electric light plant; half of the necessary funds have already been subscribed.

CHARLESTON, S. C.—F. W. Wagener & Company expect to extend their electric light plant by adding 100 horse-power engine and 100 horse-power boiler and additional electric machinery.

MASON CITY, IOWA.—T. S. Roberts, of this city, has purchased a controlling interest in the Mason City Electric Light plant. They expect at once to put in an electric street car line, connecting all the depots of the city.

ROSEAU, MINN.—A franchise has been granted for an electric light plant.

AVON, N. Y.—The electric light plant has been purchased by Aallen, Carpenter & Company.

HAMILTON, N. Y.—The contract for lighting this village by electricity has been let to the Western Electric Company, and it is expected that the system will be in operation by August 1.

CHARLEROI, PA.—The Union Electric Company has made application for charter, to supply light, heat and power by means of electricity to the public of the borough of Charleroi. John A. Irwin, James S. Carr, Harry W. Gleffer, Henry S. Stewart and others as incorporators.

SPOKANE, WASH.—Consumers' Light and Power Company has been incorporated by W. R. Newport, A. D. Hopper, J. W. Binkey, M. J. Waller and others; to build, own and operate power, machinery, etc., for generation and transmission of electrical plants for light, heat, etc. Capital stock, $250,000.

DENVER, COLO.—The People's Light, Heat and Power Company has been incorporated by William H. Brevoort, Charles F. Lacombe and Samuel E. Campbell. Capital stock, $100,000.

CHARLESTON, ILL.—Charleston Electric Company has been incorporated by Richard Cadle and others, with a capital stock of $5,000.

MONTREAL, CAN.—The Stadacona Water, Light and Power Company has been incorporated by Louis H. Tache, Joseph O. C. Mignault, Ernest Belanger and others. Capital stock, $200,000.

CROCKETT, TEX.—F. Lockfield, of Waco, Tex., has been granted franchise to put in an electric plant, to be in operation by October 1, 1895.

STANTON, MO.—The electric light bonds have been sold to C. W. French & Company, of this city.

New Electric Railways.

PORTSMOUTH, VA.—The Portsmouth Street Railway Company, of which J. G. Siegfried is president, has been granted permission to build its electric line.

TIFFIN, OHIO.—The Interurban Rapid Transit Company has been incorporated by Mesheck Frost, Amandus Betts, Morman McCarthy and others. Capital stock, $250,000.

MT. CLEMENS, MICH.—This place is to have an electric street railway system in place of its horse car service.

TOPEKA, KAS. — The Topeka Electric Railway Company has been incorporated to build an electric road between Topeka and Rossville.

LA PORTE, IND.—The Michigan City & La Porte Street Railway Company has been incorporated by H. B. Tuthill and others. Capital stock, $10,000.

WINCHESTER, TENN.—D. C. Rice, J. L. Girton and others are making arrangements to build an electric road from the Tennessee River to the property of the Tennessee & Alabama Land, Mining and Railway Company.

NORTH TRUMBULL, OHIO. — The North Trumbull Rapid Transit Company was organized in Trumbull county for the purpose of building an electric railroad for both freight and passenger traffic from Kinsman to Mesopotamia, where it will connect with a projected line to Cleveland.

EAST LIVERPOOL, OHIO.—An electric railway is to be built from East Liverpool to Lisbon.

SIOUX CITY, IA.—Arrangements have been made for electrically equipping the street car system across the river. A line is being surveyed from South Sioux City to Crystal Lake.

New Telephone and Telegraph Companies.

OBERLIN, OHIO.—The Oberlin Telephone Company has been incorporated. Capital stock, $10,000.

RACINE, WIS.—A new telephone company has been established at Western Union Junction and will operate a line between that place and Somers. The capital stock is $5,000. Officers are: President, C. A. Brown; secretary, Frank Lingsweiler; Treasurer, Dr. Stonebreaker.

CONWAY, ARK.—The Southwestern Telephone Company is putting in a telephone system for the town.

EUFAULA, ALA.—This place will shortly be connected with Clayton and Louisville by long-distance telephone.

DETROIT, MICH.—The Detroit Harrison Telephone Company has been organized. The incorporators being O. W. Shipman, Charles P. Collins, R. A. Brett, Albert Pack, Collins B. Hubbard, Frank D. Andrus, William L. Holmes and Charles Flowers.

WAPAKONETA, OHIO.—The Wapakoneta Telephone Company has been incorporated. Capital stock, $10,000.

GORHAM, N. H.—A movement is on foot to establish another telephone system in this section.

MERIDIAN, MISS.—Thomas M. Ferguson has been granted franchise to construct telephone line.

BRITT, IOWA.—The Western Electric Telephone Company filed articles; $100,000 capital. Will operate telephone exchanges in Cerro Gordo, Hancock, Kossuth, Polo Alto, Clay, O'Brien, Sioux, Lyon, Osceola, Dickinson, Emmett and Winnebago counties. The incorporators are J. T. Carr, Charles Webster, T. A. Potter.

ELWOOD, IND.—The Pana Telephone Company has sold out to the Elwood Telephone Company.

SUSQUEHANNA, N. Y.—The Susquehanna Telephone Company and the Metropolitan Telephone Company have been consolidated, and will be continued under the former title. Frank Zeller has been elected superintendent and Dr. W. W. Fletcher secretary. Dr. W. S. Mitchell has been elected treasurer.

CALAIS, ME.—Maine is to have a submarine cable all to itself. It is to be 600 feet long and will connect the lines of the New England Telegraph and Telephone Company under the Kennebec River at Gardiner.

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